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GENERAL AND MISCELLANEOUS

25734 (ANL-6333) CHEMICAL ENGINEERING DIVISION SUMMARY REPORT, JANUARY, FEBRUARY, MARCH 1961. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 250p.

Pyrometallurgical processes are being developed for recovering fissionable and fertile materials from short-cooled reactor fuels. The second laboratory demonstration of the melt-refining process with highly irradiated EBR-II-type fuel pins was completed. A 392-g charge of U–5% fissium fuel pins irradiated to an estimated burnup of 0.4 total at.% and cooled 28 days was melt refined for three hours at 1400°C. Data were not obtained on the behavior of fission products. The effect of N concentration on the nitridation rates of unirradiated U-fissium alloys in Ar–N atmospheres was determined. Experiments on the storage of fuel pins at 350°C in Ar atmospheres showed that the presence of 5% N lowered product yields only slightly during subsequent melt-refining operations. Supplementary pouring techniques, such as the use of probes and mashers designed to break crusts over the melts, are moderately effective, but are a less desirable solution to the problem of maintaining high yields than the elimination of contaminants in the Ar atmosphere. A liquid metal process is under development for recovery of the fissionable material contained in melt refining crucible skulls produced in the EBR-II fuel cycle. Information obtained in separate studies of the individual process steps is listed. A systematic study is underway to ascertain the influence of atomic size, metallic valence, and electronic configuration on the coprecipitation of various metallic elements with the Cd–Ce intermetallic phase $CeCd_{11}$. Values for the coprecipitation coefficient λ, defined by the equation log (tracer in solution/total tracer) = λ log (carrier in solution/total carrier), were determined for Na, Li, K, Y, Ba, $\lambda = 0$; La, $\lambda \pm 1.49$; Th, $\lambda = 1.08$; Pr, $\lambda = 0.63$; Ga, $\lambda = 0.23$; Sm, $\lambda = 0.17$; U, $\lambda = 0.13$; Sr, $\lambda = 0.10$; Eu, $\lambda = 0.099$; Sc, $\lambda = 0.05$; and Zr, $\lambda = 0.04$. In pilot-plant studies the reaction of 304 stainless steel tube sections with Cl was investigated in a 1½-inch-diameter two-zone fluid-bed reactor. An average penetration rate of 4.6 mils/hr was obtained in a 4.7-hour run at 575°C using 87% Cl (in N). At 625°C, using the same Cl concentration, a 35-mil tube completely reacted in 3.8 hours. The effect of Cl dilution at 625°C was noticeable at concentrations below 48 vol.%. The rate of thermal decomposition of PuF_6 was studied at 140 to 173°C by a static method and from 150 to 250°C by a flow method. A study of the kinetics of decomposition established the mechanism of the reaction. The rate of the reaction has been formulated as concurrent first- and zero-order reactions with respect to PuF_6 pressure in the range between 50 and 1100 mm at 140 to 170°C. The reaction of elemental Br with PuF_6 has been investigated. The stoichiometry of the reaction was established. Primary products of the reaction are PuF_4 and BrF_3. The utility of the reaction for the separation of U and PuF_6 was demonstrated. In studies of fission product behavior, mixtures of $UO_2 - Ru^{106}$ were reacted with F at 400 and 500°C. It was found that at both of these temperatures Ru was volatilized at a rate equal to or faster than that of U volatilization as UF_6. However, it was found that RuF_5 decomposed and was deposited on a colder portion of the walls of the fluorination vessel. Two series of in-pile, metal-water experiments were completed. Meltdowns were conducted on stainless steel-urania cermets, U wires, and on ceramic core, metal-clad fuel specimens. Cermets made of 90 wt.% stainless steel with urania showed similar behavior when submerged in water irrespective of whether the sample was in the form of pins or plates; metal temperatures greater than 1500°C were attained. The original geometry was changed into one or two large globules together with many fine particles; the more energetic transients also produced some fine (1-mil diameter) powder. Chemical analyses indicated that a separation of the urania from the stainless steel took place during the melting-quenching cycle of the reactor burst. The larger globules were depleted in U (0.017 to 0.055 wt.% U) whereas the fine particles were more concentrated in U (30 to 64 wt.% U). A Zircaloy-2 clad, ceramic core fuel pin subjected to a 648-Mw-sec pulse (606 cal/gm) on a 50 ms period gave nearly complete destruction of the specimen with 24.0% of the metal jacket reacting with the water. The data obtained to date from the various ceramic and cermet core fuel pins were correlated as a function of the energy of the reactor burst. Results at two different energies are summarized tabularly. (auth)

25735 (NYO-2904) ULTRAHIGH VACUUM TECHNIQUES. Annual Report, January 1–December 31, 1960. Research Report 808-D801-R1. M. A. Biondi, R. E. Fox, W. J. Lange, H. Riemersma, and P. M. Waters (Westinghouse Electric Corp. Research Labs., Pittsburgh). Apr. 30, 1961. Contract AT(30-1)-2176. 47p.

Activities are discussed for studies of basic phenomena associated with particle interactions with surfaces, and the development of components and techniques applicable to the studies. (B.O.G.)

25736 (NYO-9582) APPLICATIONS OF ULTRASONIC ENERGY. TASK 2: ULTRASONIC METAL AND CERAMIC POWDER PROCESSING. TASK 3: ULTRASONIC INSTRUMENTATION. Progress Report No. 26 Covering Period

February 1, 1961 to March 31, 1961. (Aeroprojects Inc., West Chester, Penna.). Apr. 1961. Contract AT(30-1)-1836. 28p.

Ultrasonic Metal and Ceramic Powder Processing. Ultrasonic activation of slip-casting molds permits the casting of thin fuel-plate configurations. Slips containing two materials of widely differing densities, stainless steel and alumina, were successfully cast with unidirectional molds. Ultrasonically activated molds are filled completely while nonultrasonic control tests resulted in less than 10% filling. The stainless steel particles remain uniformly distributed throughout the specimens produced in the ultrasonically activated mold while severe settling and particle segregation occurs in the nonultrasonic control samples. The ultrasonic axial activation of a 24-lb tamp rod and the axial activation of the thin-walled tubing during filling of 1.5-μ ceramic grade UO_2 have produced compacts with a 6.09 g/cc (55.6% theoretical) density as compared with 5.79 g/cc (52.9% theoretical) density obtained by using a 157-lb static tamp load. Ultrasonic Instrumentation. Readout equipment development to increase sensitivity of slurry particle size and concentration measurements was carried out. Readily detectable differences were observed between the acoustic power delivered into foams of various water content. Location of an air/foam and a water/foam interface in nuclear reactor systems appears to be feasible. (auth)

25737 (OMRO-PUBL-20) A REVIEW OF MATERIALS RESEARCH FOR 1960 OF THE ORDNANCE MATERIALS RESEARCH OFFICE AND THE D.O.D. LARGE SOLID PROPELLANT ROCKET MOTOR MATERIALS PROGRAM. Irving Kahn and Frank S. Hodi, eds. (Watertown Arsenal. Materials Research Lab., Mass.). June 1961. 71p.

Technical reports written during the calendar year 1960 are abstracted. Also included are summaries of contract research being conducted under the Solid Propellant Rocket Motor Materials Program. 171 references. (auth)

25738 (SC-4589(RR)) DESIGN OF THE SANDIA HIGH-ALTITUDE SAMPLER ROCKET SYSTEM (HAS). A. C. Bustamante and W. E. Walker (Sandia Corp., Albuquerque, N. Mex.). Aug. 1961. 147p.

Presented are the characteristics incorporated in the design of a ballistic rocket system capable of carrying recoverable payloads of 75 to 200 pounds to altitudes of 600,000 to 1,000,000 feet (mean sea level). (auth)

25739 (SC-4617(RR)) A COMPARISON OF STAGNATION-POINT HEATING IN A ROCKET EXHAUST TO THAT OF ACTUAL FLIGHT. Frank L. Paris, Jr. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1961. 33p.

By eliminating the body geometry, a comparison is made of the stagnation-point heating which an aerodynamic body receives in flight to the heating it would receive in a rocket exhaust. The comparison points out the need for scaling laws and similarity parameters which are then determined for both heat sink and ablation thermal protection systems. (auth)

25740 (TID-13160) PARAMAGNETIC RESONANCE OF F-CENTERS IN ALKALI HALIDES. W. C. Holton and H. Blum (Illinois. Univ., Urbana). [1961?]. 68p.

The F-center slow and fast passage electron spin resonance was observed in LiF, LiCl, NaF, NaCl, NaBr, KCl, and KBr. The hyperfine coupling of the F-electron to nuclei neighboring the negative ion vacancy was measured by electron-nuclear double resonance. Root second moments of the resonance absorption, obtained from slow passage, agree with values calculated from the hyperfine constants. In the case of LiF, the partially resolved structure existing on the slow passage resonance line is shown conclusively to arise from the F-center. The experimental results, together with those of previous workers, are compared with the Gourary and Adrian theory. (auth)

25741 (UCRL-5157(Rev.)) THEORY OF ELECTROMAGNETIC FIELD FROM A HIGH-ALTITUDE SHOT. James Paul Wesley (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 1961. Contract W-7405-eng-48. 36p.

A theoretical derivation is presented of the altitude-effect electromagnetic field produced by a nuclear bomb explosion. The electric polarization wave, which is produced when gamma rays from the bomb knock Compton electrons radially outward from the bomb, progresses through the air whose density varies with altitude. The altitude variation causes the electric polarization wave to be nonspherically symmetrical and to be the source of a large electromagnetic field, called the altitude effect field. A discussion is given of the physical mechanisms that establish the polarization wave. There is an approximate derivation of the two physical parameters of interest: the electric polarization source strength, and the reciprocal effective mean free path of gamma rays in air. The theoretically derived electric polarization wave source is substituted into Maxwell's equations. By introducing a scalar, ψ, Maxwell's equations reduce to a single inhomogeneous scalar wave equation. Green's theorem permits the scalar ψ, and consequently the electric and magnetic field components, to be expressed in the form of triple integrals over a spheroidal volume that grows in time. These integrals are presented in forms suitable for numerical integration. After the passage of the polarization wave the static charge distribution produces a static electric field. This static electric field is expressed in the form of double integrals that involve the complete elliptic integrals. (auth)

25742 (UCRL-6343) STAGE OPTIMIZATION OF THE GENERAL MULTISTAGE ROCKET. Robert H. Fox (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 16, 1961. 14p.

A simple calculational procedure was devised for stage optimization of multistage rockets. Specific impulse, engine weight and fuel tank weight may vary independently and be different for each stage. Two problems are solved, finding the maximum velocity increment for fixed payload-to-gross weight ratio and the converse problem. From the form of the equations it is found that, for the optimum configuration, a stage is large if its exhaust velocity is large or its structure factor small. The velocity increment caused by this stage is determined almost entirely by its exhaust velocity. The simplified set of equations suitable for numerical calculation are presented separately. (auth)

25743 (UCRL-6374) RESULTS AND POWER GENERATION IMPLICATIONS FROM DRILLING INTO THE KILAUEA IKI LAVA LAKE, HAWAII. Donald E. Rawson (California. Univ., Livermore. Lawrence Radiation Lab.) and Walter P. Bennett (California. Univ., Mercury, Nev. Radiation Lab.). Mar. 24, 1961. Contract W-7405-eng-48. 31p.

In November 1959 eruption at Kilauea Iki, Hawaii produced a lava lake over 300 feet deep in the volcanic crater; it contained about 100 million metric tons of molten lava. The knowledge gained is valuable to the engineering of equipment to study, and to recover power from, molten rock that might be formed by deep underground nuclear explosions or surface lava flows that might be trapped in man-made craters. The objectives of the experiment were to obtain knowledge of the drilling problems encountered while probing into

hot and even molten lava; and, if drilling was successfully completed into the melt, to obtain samples and to study the thermal environment of interest to volcanology and to power recovery studies. After drilling only 19 feet, the crust of the lake was pierced; it was then possible to make temperature measurements in the melt and to collect samples of the molten lava and gases. Completion of the experiment demonstrated the feasibility of drilling into hard rock formations at temperatures up to 850°C using standard core-drilling equipment and compressed air to cool the drilling tools and remove the cuttings. Using a mixture of water and air as the coolant, it is possible to drill with standard equipment into rock at temperatures exceeding 1050°C. The major drilling problems encountered were: (1) excessive chipping and wearing of the bits resulting from the hardness of the material, high temperatures encountered in the hole, and vibration of the small drill rig from use of air as the coolant; (2) inadequate compressed air circulation to properly remove heat when temperatures exceeded 850°C; and (3) binding of threads on the drill string caused by thermal expansion and contraction of the couplings. Binding of the threads on the drill string was overcome by use of powdered graphite as a lubricant for the couplings. Selection of more suitable drilling equipment, such as drill rig, bits, and air supply, would help overcome the vibration and heat problems. The Kilauea Iki lava lake is a significant energy source, estimated to contain about 2×10^9 kilowatt-hours of recoverable energy. The drilling experience indicates that pipes could be pushed deep into the fluid melt, making it possible to field-test power generation schemes and to measure many of the melt properties. Difficulties would be encountered in the selection of materials to withstand corrosion at temperatures up to 1250°C and in the possibility of equipment becoming bound in the melt by strong convection currents or excessive buildup of viscous lava on the pipes. A few simple corrosion experiments were performed to aid the design of equipment for measuring various properties of molten lava and equipment for testing power recovery schemes. On the various metals tested, air attack was more severe than melt attack. The most serious problems would apparently be from the attack of steam on pipes at such high temperatures. (auth)

25744 (UCRL-6397) CLOSE-IN EARTH MOTIONS, PROJECT HOBO. Final Report. L. M. Swift and W. M. Wells (Stanford Research Inst., Menlo Park, Calif.). Mar. 28, 1961. For Lawrence Radiation Lab., Livermore, Calif. Contract AT(043)-115. 56p.

Project Hobo consisted of four deep underground high explosives shots in the Oak Springs tuff of Nevada Test Site. One 100-lb, one 200-lb, and two 1000-lb charges were fired. One of the two 1000-lb shots was located at a point where the overburden depth was about 240 feet. The other shots were located under about 1000 feet of overburden. Primary measurements were those of particle velocity made at similar ranges on all shots to provide data for comparison with similar shots in salt and to explore the effect of overburden stress on wave propagation. Results of data analyses show that peak particle velocities observed in tuff were essentially identical to those produced in salt by similar shots at similar depths, and reduction of overburden stress without change of medium produces a marked reduction of peak particle velocity and an increase of pulse duration, with a less marked decrease of peak displacement. (auth)

25745 A STUDY OF MANNED NUCLEAR-ROCKET MISSIONS TO MARS. S. C. Himmel, J. F. Dugan, Jr., R. W. Luidens, and R. J. Weber (Lewis Research Center, Cleveland). Aero/Space Eng., 20: No. 7, 19, 51-8(July 1961).

The weight and size of the vehicles required to perform manned nuclear rocket missions to Mars are discussed. The effects of mission duration, radiation environment of space, and the use of atmospheric braking are evaluated. Analyses are made on the assumptions that the vehicle is for seven men and that the trip is for a 420 day mission (with 40 days at Mars). Included in this evaluation is the trajectory requirements for a round trip to Mars. The shielding requirements are discussed in terms of density and total weight in relation to the tolerable radiation doses that are expected due to solar flares and the nuclear propulsion system. (N.W.R.)

25746 THE ION ROCKET—SPACE-TRAVEL POWER PLANT WITH ELECTRON ACCELERATORS. Ernő Nagy. Fiz. Szemle, 11: No. 1, 3-12(1961).

On the basis of U. S. and Soviet publications, the schematic buildup, the principal characteristics, the elements of calculation of the ion rocket, and some comparative data are presented with advice toward practical application. The text proceeds from the classical thrust formula of the rocket: $ma = F = \Sigma n_i \cdot m_i \cdot v_i$, where n_i is the number, m_i the mass, and v_i the velocity of particles ejected per second. Substituting the ion mass of the propellant of atomic weight A and the velocities (taken from the formula of kinetic energy: $m v^2/2$) in electrical units, the thrust is expressed in terms of accelerating voltage (V) and current intensity. From this the formula of rated power and of the ratios of power/mass and specific power/thrust in kilopounds results. The calculation of the output current and of the specific propellant consumption leads to the formula of specific propellant momentum, which is also that of the specific momentum of the entire power plant: $I_{sp} = 1417\sqrt{V/A}$ kp sec/kp. The V/A ratio (accelerating voltage versus atomic weight of the propellant), the total weight of the rocket, and the ratio of thrust versus rocket weight are the most important characteristics of the ion rocket. Further practical data are obtained from the classical rocket formula: $\Delta v = v \ln m_0 m_1$ (m_0 = takeoff weight, m_1 = empty weight). The final conclusion is that ion-rocket power plants can be designed and installed in spacecraft only if electric energy sources of adequate power are found. The calculation of a Venus-probe manned spacecraft of 90 t payload is presented as an example: With a chemical propellant (I_{sp} = 300 sec), the takeoff weight would be 3000 t; with a nuclear-powered thermal rocket (I_{sp} = 800 sec), it could be reduced to 300-400 t, and with an ion rocket (I_{sp} = 10000 sec), to 180 t. Finally, data on ion rockets for various space-exploration assignments (earth satellites, moon and earth-planet probes, interplanetary probes) are tabulated. The conclusion is: While putting into orbit 1 kg of an earth satellite, 50-200 kg of takeoff and carrying rocket weight are required, so that the space exploration assignment of the example quoted appears impossible with a chemical propellant, with the aid of an ion rocket the domain of possibilities is approached. (OTS)

25747 LEGAL PROBLEMS ARISING FROM THE USE OF THE NUCLEAR ENERGY FOR THE PROPULSION OF SEAGOING SHIPS. Stanisław Matysik (Polish Atomic Energy Commission, Warsaw). Postępy Tech. Jądrowej, 3: 471-7(1961). (PAEC-RR-2) (In Polish)

Legal problems arising from the operation of nuclear powered naval vessels and the shipping rules, personnel protection, and civilian and international law are discussed. (R.V.J.)

25748 REPORTS ON ATOMIC ENERGY. BIBLIOGRAPHICAL COMPILATION WITH SUBJECT INDEX.

(Gmelin-Institut für Anorganische Chemie und Grenzgebiete, Frankfurt am Main). Feb. 15, 1961. 133p. (AED-A-1961-4)

A listing of 334 reports in alpha-numeric order according to corporate author and report number is presented. A report index arranged according to countries, a subject index, and a reactor index are included. (M.C.G.)

25749 INFORMATION ON ATOMIC ENERGY. BIBLIOGRAPHICAL COMPILATION WITH SUBJECT INDEX. (Gmelin-Institut für Anorganische Chemie und Grenzgebiete, Frankfurt am Main). Feb. 1, 1961. 175p. (AED-B-1961-2)

A listing of 305 references on atomic energy including conference papers, dissertations, and patents is presented. A subject index, author index, and patent owner index are included. (M.C.G.)

25750 REPORTS ON ATOMIC ENERGY. BIBLIOGRAPHICAL COMPILATION OF REPORTS RECEIVED BY THE GMELIN-INSTITUTE. SUBJECT INDEX FOR SERIES A, 1959, PARTS 7 TO 9. (Gmelin-Institut für Anorganische Chemie und Grenzgebiete, Frankfurt am Main). Feb. 15, 1961. 207p. (AED-BRD-A-1959)

The subject index for Series A, 1959, Parts 7 to 9 of Reports on Atomic Energy, Bibliographical Collection of Reports Received by the Gmelin-Institute is presented. The index is divided into two parts: a general subject index and a reactor index. (M.C.G.)

25751 CURRENT TRENDS IN SCIENTIFIC RESEARCH. Survey of the Main Trends of Inquiry in the Field of the Natural Sciences, the Dissemination of Scientific Knowledge and the Application of Such Knowledge for Peaceful Ends. Pierre Auger. New York, Unesco Publications Center, 1961. 240p. $6.75.

A survey of the main trends and recommendations concerning scientific research, the dissemination of scientific knowledge for peaceful ends, and the applications of scientific research are outlined. The trends apply to nearly all phases of science: fundamental sciences, earth and space, medicine, food and agriculture, fuel and power research, and industrial research. (N.W.R.)

25752 METHOD FOR CONTROLLING THE EFFECTS OF SUBTERRANEAN THERMONUCLEAR EXPLOSIONS. (to P. M. C. M. Rougeron). French Patent 1,225,816. Feb. 22, 1960.

A subterranean cavity, created by means of a preliminary explosion, is partly filled with water and evacuated, after which a thermonuclear explosion is effected in or above the body of water. This method of effecting the explosion is said to result in a greater thermal efficiency, less destruction and no crater formation. (NPO)

BIOLOGY AND MEDICINE

General and Miscellaneous

25753 (ORO-450) STUDIES OF CELL METABOLISM. Final Report. Frederick H. Kasten (Texas. Agricultural and Mechanical Coll., College Station. Research Foundation). May 20, 1961. Contract AT-(40-1)-2432. 11p.

Results are summarized from studies of cell autolysis in the Ehrlich-Lette mouse ascites tumor. This tumor is hyperdiploid and has a modal chromosome number of 47. Data are tabulated on the relative volume occupied by tumor cells in ascitic fluid, the survival time of mice inoculated with colchicine-treated ascites cells, the relation between autolysis time and longevity of mice at different dilutions of autolyzed and tumor cells, and the relation between autolysis time and longevity of mice at different dilutions of autolyzed tumor cells. The development of new staining reagents for tissue polyaldehydes is reported. (C.H.)

25754 (TID-13306) BIOLOGICAL ACTIVITY OF DEOXYRIBONUCLEIC ACIDS. Progress Report. John Spizizen and Lester O. Krampitz (Western Reserve Univ., Cleveland). July 15, 1961. Contract AT(11-1)-944. 17p.

Progress is reported in studies of the transformation of biochemical characters in Bacillus subtilis. This system has demonstrated many advantageous features for the study of the gene-enzyme relationship at the molecular level since the experimental system permits a controlled study of the genetic activity of pure desoxyribonucleic acid in the control of the synthesis of specific enzymes. Data are presented from quantitative studies of competence in transformation, the genetic control of tryptophan biosynthesis in B. subtilis, and the effect of desoxyribonuclease on the biological activity and chemical integrity of desoxyribonucleic acid. (C.H.)

25755 (AEC-tr-4482(p.776-86)) THE STUDY OF A NEW ANTI-CANCER DRUG—Hg—HEMATOPORPHYRIN—Na WITH Hg^{203}. Y. Kogawa, K. Miyatake, K. Hasegawa, and K. Higure.

The preparation, structure, and chemical properties of Hg-hematoporphyrin-Na are described. The distribution of the Hg^{203} labeled compound in the various organs of a cancerous animal, its level in relation to time, and a radioactograph of a tumor are discussed. The x-ray crystal refraction, visible absorption spectrum, and infrared absorption spectrum of the compound were determined. Ehrlich ascitic tumor was subcutaneously inoculated into a group of mice, and on the 10th day Hg^{203}-hematoporphyrin-Na was introduced into the peritoneum. Then every 5th day for one month the mice were studied with respect to the tumor, liver, kidneys, lymphatic glands, and blood. (M.C.G.)

25756 (AEC-tr-4482(p.787-98)) USE OF P^{32} IN THE TREATMENT OF LATENT RESISTANT SYPHILIS. S. Miura.

A solution containing 0.5 mc of P^{32} was injected into 6 patients with latent syphilis. After injection of the P^{32}, 4 of the 6 patients showed some change in the serum reaction and one patient turned negative in the syphilitic serum reaction. Results indicated that P^{32}, when administered to patients with latent syphilis, induced biotropism in the latent pathogenic organism. Experiments with syphilitic house rabbits confirmed that administration of P^{32} induced changes in the antibody levels of the syphilitic serum and also in the experimentally produced syphilis at the rate of 10 out of 13 rabbits. Much less change was seen in the reaction with Ca^{45} and I^{131} than with P^{32}. (M.C.G.)

25757 (AEC-tr-4482(p.813-29)) THE STUDY OF ECTOPIC BONE FORMATION BY AUTORADIOGRAPH. T. Takaoka.

Experiments were carried out on the autoradiography of phosphorus, calcium, and sulfur metabolism at the site of ectopic bone formation. Radioisotopes P^{32}, Sr^{89}, and S^{35} were used. The bladder of the immature rat was cut open and most of the muscular layer and mucous membrane were excised and both layers were folded in half and turned so that the mucous membrane faced the muscle tissue. Then these were autografted within the muscle of the internal rotators of both thighs. Four days to six weeks after the graft, 1.0 to 1.5 mc of P^{32} was administered by subcutaneous injection. Twenty-four hours after the injection the rats were killed and a sample was obtained. The relative radioactivities of the graft, muscle, and bladder were measured. The bladder mucous membrane that was grafted to the muscle proliferated rapidly accompanied by regeneration of the connective tissue in the surrounding area. Among the mucous membrane epithelia, some showed a high degree of P^{32} absorption and others showed little absorption. On the second week, a complete abcess was formed, thus cutting direct contact with the surrounding muscular tissue. A portion of the connective tissue began to show a glassy change. After the third week, 40.4% of the rats showed bony tissue formation in the area adjoining the mucous membrane of the newly regenerated connective tissue, but the mucous membrane gradually showed conspicuous, degenerative change, which was most marked in those areas adjoining the bony tissue. P^{32} absorption was seen in the newly-formed bony tissue but was not uniform, and varied in the degree of absorption. (M.C.G.)

25758 (AEC-tr-4482(p.945-59)) APPLICATION OF RADIOACTIVE ISOTOPES IN THE STUDY OF THE PERMEABILITY OF THE CELL MEMBRANE. I. STUDY OF THE PERMEABILITY OF THE RED BLOOD CELL CELLULAR MEMBRANE WITH Na^{24}. H. Imamura, N. Sasaki, I. Yoshimura, F. Tsugami, and A. Otaki.

A method was developed to measure the influx and outflux of alkali ions in red blood cells. Using this method an attempt was made to measure the amount of flux in the blood corpuscles of man and dog and to compare the results of this method with the conventional Solomon method. The difference in the sodium equilibrium in these blood cells was also determined. Na^{24} was added to whole blood and measured inside and outside of the red blood cells. The Solomon method and the shorter method were in agreement. Results showed that the influx rate was greater and the outflux rate was less in the red blood cells of a dog than in those of man. Therefore a higher sodium concentration was maintained in the blood cells of the dog. (M.C.G.)

25759 (AEC-tr-4482(p.879-903)) STUDY ON PLACENTAL TRANSMISSION OF RED BLOOD CELLS WITH THE USE OF RADIOACTIVE ISOTOPES. M. Fukuda and K. Tanaka.

In a human placental transmission experiment using P^{32} labeled red blood cells, there was no case of transmission of red blood cells in the short-term groups (10 to 110 minutes from the time of injection to the time of delivery). However, several cases showed marked radioactivity in the fetal red blood cell in the long term group (2 to 21 hours from the time of injection to the time of delivery). The differentiation of the transmission of the radioactive red blood

cells from the effect of the detached radioactivity was difficult. The Fe^{59} labeled blood cells were extremely stable, however. In the house rabbit placental transmission experiment with Fe^{59}, transmission of red blood cells was noted in 2 out of 12 control cases, 2 out of 5 cases with cholesterin injection, 3 out of 5 cases with total thyroidectomy and 2 out of 6 cases with both cholesterin injection and total thyroidectomy, but no case of transmission was seen in four cases with x-ray irradiation, which induced the most marked changes in the placenta. It was concluded that the transmissibility was greatly influenced by the degree of placental changes and the placental blood flow. (M.C.G.)

25760 (AEC-tr-4482(p.904-17)) DISTRIBUTION OF PLATELETS WITHIN THE BODY. K. Yuasa, K. Koizumi, S. Kikuchi, T. Uchiyama, T. Oshita, and F. Mitsui.

The blood platelets of a house rabbit were labeled with P^{32} and the body distribution of these platelets measured. After confirming the adequate state of the labeling, the distribution was studied. Higher radioactivity was noted in the heart, lung, liver, spleen, and kidney tissue than in the bone marrow, muscle, adrenal and pituitary glands, and cerebral and cerebellar cortex. (M.C.G.)

25761 (AEC-tr-4482(p.918-35)) THE MEASUREMENT OF RED BLOOD CELL LIFE SPAN AND RED BLOOD CELL VOLUME BY Cr^{51}. K. Toji and T. Nomura.

The measurement of the red blood cell life span and volume using Cr^{51} labeled red blood cells is described. Radioactive chromium with a valence of 6 and an anticoagulant were added to the blood. The solution containing the labeled blood cells was transfused into the veins of the subject. Samples of the blood were withdrawn once or twice a week, and their activity measured. In healthy subjects, the life span of the red blood cells was found to be from 22 to 28 days. There was marked shortening of the life span in hemolytic anemia. There was also a moderate to slight degree of shortening of the life span in leukemia, bone marrow tumor, and carcinomas. (M.C.G.)

25762 (AEC-tr-4482(p.936-42)) THE INFLUENCE OF OOPHORECTOMY OF THE I^{131} ABSORPTION OF THYROID GLAND OF WHITE RAT. T. Tsuiguchi and I. Hatake.

Oophorectomies were carried out to determine the effects of the disappearance of ovarian hormones on I^{131} absorption and distribution by the thyroid gland. Mature female white mice were used for the experiment. After having been fed a low iodine diet for about one week, the abdomens of the mice were opened and bilateral salpingo-oophorectomy was performed. At one and two weeks following the operation I^{131} solution was injected. The mice were killed at 4, 8, 24, 48, and 96 hrs and the 7th day following the injection. The thyroid gland was then removed and its weight and radioactivity determined. I^{131} distribution in the thyroid gland reached the maximum level at 48 hrs following injection in almost all cases, but in the oophorectomized group there was a significant increase in absorption. Although the weight of the thyroid gland was diminished, its rate of absorption was improved. Results indicated that the presence of the ovarian hormone suppressed the iodine absorption by the thyroid gland. (M.C.G.)

25763 (AEC-tr-4482(p.956-75)) CLINICAL APPLICATION OF I^{131} LABELED HUMAN SERUM ALBUMIN (FIRST REPORT, BASIC SECTION). K. I. Kuta, Y. K. Azuma, M. O. Kakishida, and H. Suzuki.

An investigation was made of the safety of the clinical use of I^{131}-labeled human serum albumin (HSA). Fifty μc/kg of I^{131} HSA was intravenously injected into a healthy mature male rabbit. Except for a high concentration in the thyroid gland, it was found to distribute almost uniformly in the body. The time sequence of I^{131} HSA plasma concentration, excretion rate, and thyroid gland I^{131} buildup in the normal human body was determined. (M.C.G.)

25764 (AEC-tr-4482(p.976-95)) STUDY ON DIGESTION-ABSORPTION OF POST-SURGERY DIGESTIVE TRACT WITH ISOTOPES. J. Otsuka, M. O. Kuraishi, G. R. Koshibu, M. O. Arima, M. O. Fukushima, T. O. Nakagami, S. Fuse, and T. Y. Furuya.

A study was made of absorption in the digestive tract using radioisotopes. The study was carried out on postoperative cases of total gastrectomy and its combination with the resection of the pancreas and spleen. P^{32} phosphoprotein was used to study the digestion and absorption of protein. S^{35}-containing amino acids in the form of methionine and cystine were prepared in yeast body protein. The amino acids were used to investigate the resorption capability eliminating the effect of digestive capacity. The absorption of fats was studied using I^{131}-labeled sesame oil. Absorption state curves were plotted. (M.C.G.)

25765 (AEC-tr-4482(p.1005-23)) MEASUREMENT OF I^{131} THYROID UPTAKE. K. K. Kakihi.

Studies indicated that the errors in measurement of I^{131} uptake by the thyroid gland are due to the following factors: change in gamma spectrum due to absorption and scattering, phantom for standard radioactive source measurement, formula, shape and volume of standard radioactive source, scattering ray eliminating filter plate and thyroid shielding filter plate, isoresponse curve of measuring apparatus, collimation, and working distance. It was found that about $^3/_4$ of the error could be eliminated by the employment of apparatus applicable for gamma spectrometric analysis. (M.C.G.)

25766 (AEC-tr-4482(p.1024-36)) ON THE FUNCTION OF THE THYROID IN PERTHES' DISEASE AND SIMILAR CONDITIONS. Y. S. Murakawa and Y. H. Takemitsu.

Measurements were made of the I^{131} urinary excretion rate, plasma protein-bound iodine conversion rate, and thyroid scintigram in Perthes' disease children, in cases with similar conditions, and in control children of the same age group. In measurements of the urinary excretion rate, 14 children with Perthes' disease showed on the average a 6.9% increase in the excretion rate in the first day. In studies of the plasma protein-bound iodine conversion rate, an average value of 26.1% was obtained in the Perthes' disease, 27.5% in the controls, and most of the other cases fell within the normal range. The thyroid scintigram measurements showed no marked change from the normal in any of the cases. (M.C.G.)

25767 (AEC-tr-4482(p.1037-66)) INFLUENCE OF HYPERTHYROIDISM TREATMENT WITH I^{131} ON THE HISTOLOGICAL PICTURE OF THYROID GLAND AND ITS CORRELATION WITH THYROID FUNCTION. K. K. Saito, S. T. Ishida, K. Z. Sanada, and A. H. Takeda.

Histological examinations were made of the thyroid gland in 22 cases of hyperthyrodism during the periods prior to and after administration of I^{131}. The histological picture was observed in the post-administration period in 62 cases. As control the histological picture of a simple nodular goiter was studied in 8 cases after I^{131} administration. At the time of each examination, the thyroid function test was performed and a comparative study of its findings with the histological picture was made. In hyperthyroidism, the first change following I^{131} administration was the nuclear change. It was observed in 68.8% of the cases examined within 10 to 108 hrs after administration. A group of cell nuclei underwent thick staining to hematoxylin and swelled to irregular shapes and variable sizes. After I^{131} adminis-

tration the following changes occurred: the thyroid follicles became much smaller in size, irregular in shape, and increased in number; papillary proliferation of follicular epithelium either diminished or disappeared; follicles tended to lose their colloidal content; and slight interstitial proliferation occurred. The change in histological features as well as the clinical picture by I^{131} was not as marked in the simple goiter as it was in hyperthyroidism. The correlation of the histological picture, before and after treatment with I^{131}, with the thyroid function is discussed. (M.C.G.)

25768 (AEC-tr-4482(p.1067-82)) TREATMENT RESULT OF 500 CASES OF HYPERTHYROIDISM WITH I^{131}. K. O. Yamashita, Z. I. Fujita, M. T. Masuko, H. J. Hattori, T. S. Ohota, M. F. Honda, and T. O. Uemura.

Observations on the progress made in the treatment of 500 cases of hyperthyroidism with I^{131} are reported. Among the 500 cases, 430 were female and 70 were male. Dosages of I^{131} were administered orally and the amount regulated by the size of the thyroid, basal metabolism rate, and age. Clinical progress of side-effect symptoms including fatigue, diarrhea, fever, increased palpitation, nausea, insomnia, and stomach ache is summarized. Most cases began to improve a few weeks after administration of the dose and became stabilized in two months. Effects on thyroid mass, blood pressure, tremor, change of body weight, sweating, mental symptoms, and exophthalmus are also discussed. Changes in electrocardiograms before and after treatments are described. (M.C.G.)

25769 (AEC-tr-4482(p.1083-92)) THE ACTION OF Au^{198} ON THE YOSHIDA SARCOMA. Y. Koga and T. Kasai.

The following effects of Au^{198} on the Yoshida sarcomatous rat were studied: the changes in the total number of the cancerous cells; the fate of the destroyed cell; the presence or absence and the nature of changes in the cell; and the survival time of the white rat. The injection of over 200 μc had a preventive effect on the increase of the Yoshida sarcoma. The most effective amount for the injection was thought to be 700 μc to 1 mc. A prolongation of survival days was noted when over 500 μc was injected. Judging from observations of the ascitic fluid smear, the vacuole formation in the cell body was the most marked change and the cell nucleus tended to swell and dissolute. By means of radioautography, the distribution of Au^{198} particles was found to be coincident with that of the tumor cell and it is thought that the Au^{198} particles are absorbed in the surroundings of the tumor cell and that some of it enter the tumor cell. (M.C.G.)

25770 (AEC-tr-4482(p.1093-9)) THE STUDY OF THE TREATMENT AND CLINICAL EXPERIENCE IN THE TREATMENT OF THE ANIMAL TUMOR, USING Au^{198}. Y. Kishigami.

The action of Au^{198} with respect to changes in the number of tumor cells, the morphological changes of tumor cells, and the survival days was studied using Ehrlich ascites cancerous mice. In addition, among 73 patients with malignant tumor, 36 cases of intraperitoneal injection, 15 cases of intrapleural injection, and 22 cases given other clinical treatment were studied. It was concluded that with repeated injections of an adequate amount of Au^{198} over a certain period of time, successful treatment of the ascitic cancer of mice may be possible. The results of the 73 treated cases are presented in tabular form. (M.C.G.)

25771 (AEC-tr-4482(p.1100-17)) EXPERIMENTAL STUDIES ON THERAPEUTIC APPLICATION OF RADIOACTIVE COLLOIDAL GOLD (Au^{198}). H. Nakazuka and T. Kunai.

Experimental results are given on the influence on the tumorous ascites, tumorous cell, and the differences in body distribution by the various methods of administration of Au^{198}. For experimental animals male mice, rats, and rabbits were used. When colloidal Au^{198} was injected subcutaneously or injected directly into the subcutaneous tumor, most of it was absorbed at the site of injection and only one to two percent of the administered Au^{198} was absorbed by various organs. When it was injected intramuscularly, most of it was also absorbed at the site of the injection and only about 5 to 8% of the totally administered Au^{198} was found in the various organs. When colloidal Au^{198} was injected intravenously, most of it was absorbed by the liver (80 to 95%) and bone marrow, spleen, and lymphatic system in that order. When the colloidal Au^{198} was injected intraperitoneally it was precipitated on the surface of the peritoneal membrane and also was phagocytized by the lacteal of greater omentum, giant phagocytes, and intraperitoneal monocytes. About 50 to 60% of the total was absorbed by the liver and 4% by bone marrow. When colloidal Au^{198} was administered intraperitoneally to the Ehrlich-tumor mouse, the accumulation of ascitic fluid was suppressed and prolongation of the life span was noted. (M.C.G.)

25772 (AEC-tr-4482(p.1118-35)) THE TREATMENT OF A MALIGNANT TUMOR BY RADIOACTIVE GOLD (Au^{198}). M. Okubara, R. Monba, K. Konoda, K. Honda, H. Katamoto, and K. Kinuya.

The injection therapy of colloidal Au^{198} solution was carried out in 80 patients with carcinomas of the stomach, uterus, breast, and upper jaw, and also with various other malignant tumors. Its effect and side reactions are described and discussed. Most of the Au^{198} particles that were injected into the tumor tissue remained in the area of injection and caused the destruction or changes in the cancerous cells through its radioactivity. The distribution of the Au^{198} tended to be extremely uneven. With the amount of Au^{198} used for the injection, unless there was an additional trauma of operation, there was only a light degree of radiation sickness, a slight decrease in the white blood cell count, mild fever, and localized swelling of the injection site. There were 52 patients in the early and middle stages of cancer and the 2-yr survival rate among these groups was 73%. This result was relatively better than that of other therapeutic methods for malignant tumors. (M.C.G.)

25773 (AEC-tr-4482(p.1136-60)) THE TREATMENT OF LYMPH NODE METASTASIS OF CARCINOMA OF THE CERVIX UTERI WITH CRI ($Cr^{32}PO_4$, Au^{198}). S. Iwai, H. Takizawa, and R. Nakazawa.

An attempt was made to determine the efficacy of radioactive chromium phosphate and radioactive colloidal gold solutions on the treatment of lymphatic metastasis of the carcinoma of the cervix uteri. With $CrP^{32}O_4$ emulsion the concentration of P^{32} particles was noted in the lymph nodes, but the rate of its absorption by other tissues was small. However, only 1% of the injected amount was absorbed by the resected lymph nodes, while most of the P^{32} remained in the local area of injection. The Au^{198} was somewhat superior in this respect, but neither material was absorbed by the tumor tissue and both materials were absorbed only by the residual normal lymph nodal tissue. From these findings it was concluded that the use of these two materials in the therapy of lymph node metastasis does not have direct beneficial effect but that it does have some supplementary therapeutic effect. (M.C.G.)

25774 (AEC-tr-4482(p.1161-85)) STUDIES ON THE CLINICAL APPLICATION OF Y^{90} ($Y^{90}Cl_3$). M. Miyagawa, K. Yoshizawa, and H. Nakazuka.

A study was made of the clinical application of the Y^{90} colloid. $Y^{90}Cl_3$ was prepared and injected intravenously. The following cases were treated: a 40-year-old housewife with splenic tumor, a 54-year-old man with a recurrence of carcinoma of the penis, three cases in which high resection of the bladder tumor was performed, a 68-year-old male with a transitional epithelial tumor on the right side of the inner wall of the bladder, and a 65-year-old male with a mammillary tumor of the bladder. Most of the cases showed only a transient improvement because of the gravity and lateness of the stage of their disease. (M.C.G.)

25775 (AEC-tr-4482(p.1186-9)) EFFECT OF Co^{60} RADIATION ON HUMAN UTERINE CANCER CULTURE CELLS (He La CELL). H. M. Fujimori, N. Azuma, and F. O. Yamada.

Studies were made of the effects of gamma radiation from Co^{60} on human uterine cancer culture cells (He La cells). Against the strong proliferation curve in control, the curve of the irradiated culture showed a declining tendency with a 2,000 r irradiation and was approximately horizontal with 500 r. Investigations with the stained picture method showed that, when irradiated, the cell as a whole becomes swollen, a part of the peripheral portion of the cytoplasm appears disintegrated, and division and disintegration are observed in the chromatin. (M.C.G.)

25776 (AEC-tr-4482(p.1190-1202)) EFFECT OF Co^{60} DISTANCE BODY RADIATION TO MOUSE LIVER CATALASE ACTIVITY VALUE AND BLOOD SUGAR LEVEL. H. M. Fujimori, F. O. Yamada, M. O. Maeda, and Y. H. Ikeziri.

Research and relevant statistical studies regarding the change in liver catalase activity value and blood sugar level as side effects of Co^{60} radiation and regarding the so-called radiation toxin, which is produced in the body by ionizing radiation. Mouse liver catalase activity value in Co^{60} radiation was highest in the glucurin subcutaneous injection series. It appeared that single dose radiation series had less effect. Co^{60} radiation lowered the blood sugar level temporarily but showed signs of recovery from the third day. An increase in the radiation dose promoted the lowering of the blood sugar level. The effects of Co^{60} irradiated rat serum injected into mice livers on the catalase activity value and blood sugar level were studied. (M.C.G.)

25777 (AEC-tr-4482(p.1203-15)) THE EFFECT OF RADIOACTIVE PHOSPHORUS (P^{32}) ON RABBIT BLOOD, PARTICULARLY ON LEUKOCYTE FUNCTION. S. T. Miyaji.

A study was made of functional disturbances of leukocytes in rabbit blood when P^{32} was administered internally. Blood changes, including volume of hemoglobin, red and white cell count, monocytes, lymphocytes, average number of nuclei of monocytes, wandering speed of monocytes, and their phagocytosis through single administration of a varied dose of P^{32} by injection, were observed with the passage of time. After administration of P^{32}, hemoglobin volume and erythrocyte count decreased from the first day and reached their lowest level on the 3rd day in the 0.25 mc/kg series, while it was on the 21st day in the rest of the series. The total number of leukocytes and the monocyte count increased transiently the first day of injection and later decreased. From the changing state of the nuclei and from variations in the function of wandering and phagocytosis in monocytes, the following assumptions were made regarding the effect of P^{32} to the bone marrow: it is suppressive with 0.25 mc; it is either suppressive or impairing with 0.5 mc; and it is impairing with 0.75 mc to 1.0 mc. (M.C.G.)

25778 (AEC-tr-4482(p.1216-37)) LIVER DAMAGE IN A P^{32} INJECTED MOUSE. T. Sakurai and S. Z. Asakino.

In order to observe its effect on various organs, P^{32} was administered to mice, the intensity of the radiation received by the various organs was measured, and, at the same time, changes in body weight, morphologic change of liver tissues, as well as the behavior of the tissue nucleic acids were followed. The relationship between liver tissue damage and intra-tissue radiation dosage was studied. Body weight decrease became more marked with the passage of time in the 300 μc injection series while in the 100 and 50 μc injection series it temporarily decreased and then rose to the previous level or above it. The P^{32} uptake rate of each organ was high 3 to 6 hr after injection and rapidly decreased after 24 hr. However, bone marrow showed a high uptake rate from 24 hr to 5 days. The concentration was high in the bone, liver, and spleen and low in the lungs and testes. In general, the state of emergence of the abnormal cell was characteristic, depending on the amount of injected P^{32}. Functional change, judged from the morphologic change of tissue and abnormal distribution of nucleic acids, was more advanced with an increasing amount of P^{32}. The recovery picture of the tissue was observed 14 days after injection. (M.C.G.)

25779 (AEC-tr-4482(p.1238-49)) EXPERIMENTAL ANOMALY OF FETUS PRODUCED BY P^{32} INTERNAL RADIATION. Y. O. Kameyama.

P^{32} was administered to mice in an early stage of pregnancy and the effect of beta particles on fetal morphological development, particularly the pathologic process of anomaly formation was investigated. From 2 to 20 μc per gram of P^{32} were injected on the 8th day of pregnancy. Through the investigation carried out 5 days later, it was found that with a dose of more than 15 μc per gram, death occurred in all cases by the time of sectioning. From 24 to 66% of the embryos, with doses ranging from 2 to 15 μc per gram, died and morphologic anomaly occurred in from 25 to 47% of the surviving embryos. All anomalies produced belonged to the central nervous system and, with the exception of pseudencephaly and some cases of bowing of the spinal cord, generally outward changes were slight and no variable anomaly was produced. However, in the histological study, an extensive abnormal proliferation mechanism of nerve tissue was observed not only in the abnormal embryo but also in embryos with normal appearance. It was therefore concluded that when P^{32} enters the embryo of early fetal life, its beta radiation exerts selective and sustaining disturbances to the highly sensitive central nervous sytem. (M.C.G.)

25780 (AEC-tr-4482(p.1254-60)) ON HISTOLOGIC CHANGE OF A FEW ENDOCRINE ORGANS IN THYROID FUNCTION ABNORMALITY. S. H. Higuchi and Y. T. Itto.

I^{131} was administered through the abdominal cavity of rats and its effects on the thyroid gland was observed histologically. At the same time, the effect of thyroid function defect by radiothyroidectomy on hypophysis, adrenal gland, and the ovary was investigated. From the third day of administration of I^{131}, the thyroid function decreased. In the anterior pituitary gland, an increase in number, enlargement of size, and vacuole-formation were noticed in basophilic cells while acidophilic cells decreased. No marked change was recognized in the ovary or in the adrenal gland. (M.C.G.)

25781 (AEC-tr-4482(p.1330-46)) STUDIES ON LETHAL CONDITIONS FOR FOOD BACTERIA ESPECIALLY E. COLI, BY USE OF THE GAMMA RAY. W. Watanabe and S. Sasaki.

The resistance of E. coli to gamma radiation was investigated. The bacteria were incubated for 24 hr at 37°C, and suspended in a phosphate buffer. The relationship between survival and dose is presented in graphical form. The lethal curve for E. coli was the same for each concentration. Other bacteria were also studied. The effects of the temperature during the treatment of the sample after irradiation, the stocking period over certain temperatures on survival, the presence of the dead cells on the susceptibility of the living bacteria, and the additions of sugars, organic acids, and salts on survival were investigated. (M.C.G.)

25782 (AEC-tr-4482(p.1347-62)) STUDIES ON THE VIRULENCE OF BACILLUS TUBERCULOSIS BY USING P^{32} LABELED BACILLUS TUBERCULOSIS. PART 2. THE RELATIONSHIP BETWEEN THE VIRULENCE AND BACTERIAL LIPID. Y. Yamamura, T. Terai, and K. Ogura.

A study was made of the phagocytosis in vivo for Bacillus tuberculosis and the role of the bacterial lipid on it. For this purpose labeled and heat-sterilized bacteria were used to eliminate the effect of multiplication and P^{32} turn-over. These bacterial cells and their defatted cells were injected into a mouse. Radioactivity due to P^{32} existed in the whole body and internal organs and was traced day by day. The in vivo digestion and discharge of these cells were studied. It was observed that when the heat-sterilized cells were injected, virulent cells were digested more slowly than non-virulent cells. With the cells defatted by alcohol-ether and chloroform, the disappearance of P^{32} was the same for both virulent and non-virulent strains, that is, virulent and non-virulent cells were digested and discharged in the same way. These results suggested the presence of substances which retard the digestion and discharge in vivo of the cells in the lipid of the virulent Bacillus tuberculosis. When the cells coated with cord factor wax C, and wax D were injected, the secretion of P^{32} from the mice was slower than that with the non-coated cells. It was assumed that this was not due to the indirect injury of the living body by a virulent substance in the lipid, but due to the difficulty of phagocytosis and digestion by leukocytes caused by the coating with lipid. (M.C.G.)

25783 (AEC-tr-4482(p.1363-78)) STUDIES ON THE PHOSPHORIC ACID METABOLISM OF BACILLUS TUBERCULOSIS WITH P^{32}. PART 2. M. Sumida, H. Shigekane, M. Yamamoto, K. Ando, Y. Miyashita, T. Yamamoto, J. Kawabe, K. Hattori, S. Tanaka, and H. Niitani.

The acid soluble fraction of Mycobacterium tuberculosis avium was separated into each nucleotide by using Potter's gradient system. The incorporation of P^{32} into the nucleotides and the effects of streptomycin on them were studied. With the streptomycin-sensitive bacteria, the incorporation of P^{32} was increased by the addition of streptomycin. Nucleic acid was isolated and separated, and ion exchange chromatography with synthesized Eteocolla–Cellulose was applied. It was found that RNA was eluted with the salt solution of relatively low concentration, and DNA was isolated by the solution of higher pH. It was observed that streptomycin inhibited the incorporation of P^{32} into each fraction and this inhibition was smaller in the DNA-rich fraction. The presence of the polyphosphates was recognized in the nucleic acid fraction of Mycobacterium tuberculosis avium, and its separation was tried. The polyphosphate fraction had higher metabolic activity and it seemed that it acted as the phosphate pool. It was observed that streptomycin also inhibited the incorporation of P^{32} into this fraction and the metabolic cycle. Polynucleotide phosphorylase was isolated by Ochoa's method in order to directly study the effect of streptomycin on the metabolism of RNA and polyphosphates in the cell-free condition. The results showed that streptomycin inhibited the enzyme action. These results indicated that streptomycin could inhibit the biosynthesis of high molecular acidic substances in the phosphoric acid metabolism of the Bacillus tuberculosis. (M.C.G.)

25784 (AEC-tr-4482(p.1379-87)) STUDIES OF THE MECHANISM OF LIGHT SENSITIZATION OF THE RETINA BY THE USE OF P^{32}. PART 2. I. Honjo, Y. Oki, and M. Kato.

The P^{32} outflux from retina to medium was observed by the irradiation of a frog retina whose visual cell was labeled with P^{32}. The effects of additions of anti-metabolites and chemicals were investigated. The anti-metabolites had no apparent effect on the outflux of P^{32}. Ethyl and methyl alcohols inhibited the P^{32} outflux. The relationship between the P^{32} outflux and the light sensitization mechanism of the retina is discussed. (M.C.G.)

25785 (AEC-tr-4482(p.1405-18)) APPLICATION OF RADIATION TO THE BREEDING OF TOBACCO. Seiji Matsumura, Taro Fujii, and Masao Tanaka.

Several strains of tobacco were irradiated with x rays and gamma rays and many mutants were found among the offspring. Individuals with useful characteristics were selected from the mutants and used for breeding. In order to increase cross-fertility, x rays and gamma rays were applied on pollen grains of wild tobacco. Irradiated pollen grains were used for interspecific crossing with cultivated tobacco to induce resistant characteristics from the wild type. The difference in sensitivity in different varieties and in the same variety in different years is discussed. With the increase of the radiation dose, the rate of mutation increased. It was found that 30 Kr is a suitable dose for the introduction of mutations. Useful mutants with disease-resistant properties, better quality and higher yield were obtained. The aging of irradiated pollen for 10 days increased the ratio of solidity of the seeds. (M.C.G.)

25786 (AEC-tr-4482(p.1419-38)) STUDIES ON THE MECHANISM OF MOLTING OF HENS–ESPECIALLY ON THE RELATIONSHIP BETWEEN THE THYROID GLAND AND THE OVARY. Yuichi Tanabe, Kentaro Himeno, and Hiroshi Nozaki.

Attempts were made to induce molting in hens by administering various hormones and drugs to the hens. The upheaval of the function of the thyroid gland during the natural molting of hens was studied using I^{131}. Administration of thyroxine and thiouracil caused molting in all the adult hens. The administration of progesterone caused molting in hens but its effect was weak for cocks. The non-laying hens began to molt earlier than the others. Injection of estrogen completely stopped the molting of the hens in the fall. The administration of enheptin caused non-laying of the hens. The rate of secretion of the thyroid hormone during the laying and molting was studied by continuous measuring, from outside the body, of the rate of release of I^{131} from the thyroid gland. Results indicated that the natural molting of hens is caused by the decrease of estrogen secretion due to the deterioration of the ovarian function, accompanied by non-laying, under the condition of senility of the tissues which hold the feathers, more than 6 months after the stopping of the growth of new feathers, and not by the upheaval of the function of the thyroid gland. It was therefore decided that molting is caused by non-laying and that molting does not cause non-laying. (M.C.G.)

25787 (AEC-tr-4482(p.1439-54)) STUDIES ON METHIONINE SYNTHESIZING BACTERIA IN GOAT INTESTINES BY USING S^{35} AND THE RELATIONSHIP BETWEEN

THE DISTRIBUTION OF S^{35} IN THE BODY AND INTERNAL SECRETION. Goro Muraoka.

By the oral administration of S^{35} to goats, it was found that the isotope accumulated in the brain, testicle, and especially in the gland epithelial cells. An attempt was made to isolate the bacteria in the feed which can convert the inorganic sulfate into sulfur protein and to determine the distribution of the bacteria in the goat intestine. The relationship between the methionine produced in the intestines using S^{35} and the internal secretion of hormones in the generative organs was studied. (M.C.G.)

25788 (AEC-tr-4482(p.1455-66)) STUDIES ON THE EFFECTS OF VITAMIN D AND Ca: P RATIO ON THE CALCIUM METABOLISM OF CHICKENS. Hiromu Ito, Soki Horikago, Kunio Kawashima, and Tadashi Hatano.

Tracer techniques were used to study the effects of vitamin D and the Ca: P ratio in feed on the calcium metabolism of chickens. The chickens were given low-phosphorus feed and under the conditions of Ca: P ratios of 2: 1 and 4: 1 various amounts of vitamin D were administered. $Ca^{45}Cl_2$ was then given orally and intramuscularly, and the radioactivity of the excretion and bone in 3 days was measured. The body weight at the 18th day was larger for Ca: P of 2: 1 than for 4: 1. No effect of the variation of the amount of vitamin D on body weight was observed. Results showed that vitamin D was effectively used for the absorption of calcium and its storage. (M.C.G.)

25789 (AEC-tr-4482(p.1467-87)) STUDIES ON RADIOACTIVE LABELED BACTERIA IN THE FIELD OF FOOD SANITATION. Akira Takase and Tomoko Bito.

The conditions for labeling bacteria with radioactive isotopes were studied. The labeled bacteria were used for studies of the contamination mechanism of raw, sliced fish at the time of its processing. At the same time, consideration of the conventional experimental method in the field of food sanitation was given. The conditions for labeling E. coli with P^{32} were determined. The best storage method for the labeled bacteria was to leave the cell suspension in a refrigerator. The contamination sources for fresh sliced fish meat were considered. The cooking board, knife, fingers, and hands were coated with the labeled bacteria, and the transfer of the bacteria to the sliced fish meat was studied. The results of the experiment showed that the cooking board was the most important source of contamination. The Swab wiping method of removing bacteria from cooking tools was tested by using labeled bacteria with the board and knife. The recovery differed greatly depending on the way of wiping, and a maximum of 80% was recovered by one wiping. For complete recovery at least 4 wipings were necessary. The penetration of the bacteria into the sliced fish meat was studied by immersing a piece of fish meat in the labeled cell suspension with or without shaking. It was found that the penetration could be neglected when the meat was immersed for less than 30 min, and with shaking 50 times. (M.C.G.)

25790 (AEC-tr-4482(p.1488-1529)) DIRECT ABSORPTION OF RADIOACTIVE ISOTOPES IN WATER BY SALT AND FRESH WATER FISH. Tetsuo Tomiyama and Kunio Kobayashi.

Studies were made of the absorption, distribution, and excretion of Ca^{45}, $Sr^{90}(Y^{90})$, Y^{91}, Zr^{95}, P^{32}, and I^{131} by various fresh and salt water fish. Ca^{45} and $Sr^{90}(Y^{90})$ were absorbed by fresh water fish chiefly through the gill. The rate of digestion and absorption of Ca^{45} in feed was low. Ca^{45} was absorbed by salt water fish through the gills and digestive tracts. The absorption of $Sr^{90}(Y^{90})$ by eels was studied under both salt water and fresh water conditions. In both cases absorption was chiefly through the gills, but for salt water fish, absorption through the digestive tract was also observed. The amount of absorption into the body was much larger in fresh water than in salt water. The Sr^{90} accumulated chiefly in the hard tissues and Y^{90} accumulated in the gills, body surface, and liver. In fresh water, 91% of the excreted $Sr^{90}(Y^{90})$ isotopes was found in the urine, and, in sea water, 70% was excreted from the gills. Under both water conditions, Zr^{95} accumulated in the gills and surface mucus, distribution in the body was small, and 65% of the excretion was found in the urine. P^{32} was absorbed by fresh water fish directly through the gills, was accumulated in the blood, liver, and heart, and 90% was excreted in the urine. I^{131} was absorbed directly from the whole surface of the fish, accumulated mainly in the kidney and liver, and 67% was excreted in urine. S^{35} was absorbed slightly by fresh water fish. (M.C.G.)

25791 (AEC-tr-4482(p.1530-40)) STUDIES ON THE ABSORPTION OF STRONTIUM BY SALT WATER FISH FROM SURROUNDING WATER. Ryusuke Ichikawa and Yoshio Hiyama.

The effect of the concentration of Sr and Ca in sea water on the uptake of Sr into tissue and bones of sea fish was studied. The sea water for the experiment was prepared by the addition of various amounts of Sr and Ca into natural sea water, and fish were bred in it. The water was labeled with Sr^{90}, and the amounts of Sr absorbed in the tissues and bones of the fish were determined by measuring the radioactivity of Sr^{90}. The amounts of Sr absorbed in the fish body increased with the increase of the concentration of strontium in the surrounding water. The increase of the concentration of calcium in the sea water did not show great effect, but slightly decreased the uptake of strontium. (M.C.G.)

25792 (AEC-tr-4482(p.1541-59)) STUDIES ON DETECTION OF Cd^{113m} AND Cd^{115m} IN RADIOACTIVE CONTAMINATED FISH AND THEIR MOVEMENT IN THE BODY OF THE FISH. Kazuo Shirai and Kojiro Mori.

Gold fish, Therapon jarbera, Sphoeroides niphobles, and eel were bred in fresh water or sea water containing Cd^{115m} and fission products. It was found that Cd^{115m} was selectively absorbed from the fission products. The absorption was found to be less by salt water fish than by fresh water fish. The movement of the Cd^{115m} in the body of the fish after absorption was determined. (M.C.G.)

25793 (AEC-tr-4482(p.1560-97)) STUDIES ON NUCLEAR SPECIES IN CONTAMINATED FISH AND THEIR MOVEMENT IN THE BODY OF THE FISH. Seido Saheki, Rakeshi Yasumoto, and Kojiro Mori.

The uptake and retention of the radioactive isotopes Zn^{65}, Mn^{54}, $Ba^{140}-La^{140}$, $Sr^{90}-Y^{90}$, Sr^{89}, and Fe^{55} by fish bred in the laboratory were studied. The isotopes were absorbed easily by the fish from the surrounding water containing these species. When these radioactive fish were transferred into normal water, $\frac{1}{2}$ to $\frac{1}{4}$ of their radioactivity was lost in a short time (2 to 7 days). After this period the decrease in the radioactivity was quite slow. $Ce^{144}-Pr^{144}$ and $Ru^{106}-Rh^{106}$ were also studied. These isotopes were easily absorbed by the fish. Absorbed $Ce^{144}-Pr^{144}$ was found chiefly in the digestive tract and its juice. When fish contaminated with these isotopes were transferred into normal water, most of the radioactivity was lost in 3 to 9 days. (M.C.G.)

25794 (AEC-tr-4482(p.1607-16)) ANALYSIS OF THE RELATIONSHIP BETWEEN ORGANS OF RICE PLANTS VIEWED FROM THE MOVEMENT OF ASSIMILATED PRODUCTS. Nobuaki Ishizuka and Akira Tanaka.

In order to clarify the mutual relationship between each

part of a rice plant, the tracing of the movement of the assimilated products of the leaves was carried out using C^{14}. The method used for assimilating C^{14} at various leaf positions during each stage of growth is described. Analysis of the plants later revealed that most of the C^{14} was converted in the plants from the carbonate to organic compounds, chiefly sucrose. The division of the work between the leaves of the different leaf positions of the stem is discussed. (M.C.G.)

25795 (AEC-tr-4482(p.1617-33)) STUDIES ON Mo AS A TRACE ELEMENT BY USE OF Mo^{99}. Yoshio Yamado, Tadao Miyaguchi, Hideaki Kahi, and Satoshi Tamai.

The application of Mo^{99} in the study of molybdenum as a trace element in plants was investigated. The following topics were considered: the purity of Mo^{99}, removal of Mo from reagents and distilled water, the movability and distribution of Mo in the plant body, the fixation of Mo in the soil, and the colorimetric determination of Mo. The results indicated that the application of radioisotopes is useful for studies of this trace element. (M.C.G.)

25796 (AEC-tr-4482(p.1634-45)) THE NUTRITIONAL STUDIES OF CROP PLANTS BY USING RADIOISOTOPES. PART 2. Zenzaburo Kazunishi, Hitoshi Nakada, Shigeyoshi Konishi, Kozi Asada, Yasuyuki Yamada, and Azuma Okuda.

Radioisotope techniques for studies on the effects of nutritional condition of plants on the behavior of the nutrients absorbed from fertilizer are described. Young colza plants cultivated under different phosphorus nutritional conditions were used. P^{32} was given at the fruiting stage and its distribution in the branches was traced after 1 and 4 days. The results showed that the distribution ratios of phosphorus in each branch were uniform in the plants that were given enough phosphorus fertilizer, but with the phosphorus-deficient plants, the accumulation of phosphorus in the branches was not uniform, and this tendency became larger with the lapse of time. The same experiment using K^{42} as a tracer with tobacco plants which were cultivated under different potassium dressing conditions was carried out. The same tendency that was obtained with phosphorus was observed. (M.C.G.)

25797 (AEC-tr-4482(p.1646-1662)) THE IMPROVEMENT OF FERTILIZER DRESSING AND SOIL MANAGEMENT IN THE RICE FIELD—FIELD TEST IN THE RICE FIELD BY USING CALCIUM SUPERPHOSPHATE LABELED WITH P^{32}. Susumu Nishigaki, Masao Shibuya, Takeo Koyama, Ikuko Hanaoka, Seigo Sasaki, Chikataka Okada, Masaki Komatsu, Ikuo Noguchi, and Chu Shioda.

To obtain the fundamental data for the improvement of the fertilizer dressing in the volcanic ash soil, the phosphorus fertilizer test using tracer techniques was carried out in a poor drainage rice field. The required minimum specific activity of the tagged fertilizer was over 50 μc per gram of P_2O_5. This quantity was necessary to secure the determination of P^{32} in the rice plants after harvest. The utilization of superphosphate was found to be 7.3%, but the portion of the phosphorus derived from the fertilizer was 20%. It appeared that the phosphorus of the fertilizer was utilized by the plants during the first two months of plant life. The available phosphorus in the soil during the rice growth was estimated and a large value, compared to the fertilizer phosphorus, was obtained. (M.C.G.)

25798 (AEC-tr-4482(p.1663-9)) THE EFFECT OF AN OXIDATION-REDUCTION SYSTEM IN SOIL ON THE ROOT ACTIVITY OF RICE PLANTS. Susumu Nishigaki, Masao Shibuya, Takeo Koyama, and Ikuko Hanaoka.

The root activity of rice plants standing in the field was measured by using P^{32} and the determination of the root activity in the different periods of growth and at the different spots in the soils was possible by this method. P^{32} labeled fertilizer was given to the rice plants and the radioactivity of P^{32} in the rice plants at each period of growth was measured. The experiment was carried out in volcanic ash soil and a poorly drained field. Results showed that the root activity began to decrease in early August, and at the same time the rate of the fertilizer uptake also decreased. As long as the irrigation was continued the root activity did not recover. But by temporary drainage for one week, the root activity and rate of fertilizer uptake increased again. It was concluded that in the field soils having a uniform reduction-oxidation system, the procedure for periodical exchange of the system, such as temporary drainage, can help improve the low yield of the field. (M.C.G.)

25799 (AEC-tr-4482(p.1670-8)) STUDIES ON THE PREPARATION OF LABELED LIME NITROGEN AND ITS USE. PART I. ON THE MANUFACTURING OF LIME NITROGEN LABELED WITH Ca^{45} AND C^{14}. Shoichi Yanagisawa, Teizo Morishita, Toshihiko Sakaida, and Nobuo Mizutani.

The preparation of lime nitrogen, cyanamide, is discussed. For the preparation of $CaCN_2$ labeled with Ca^{45} and C^{14}, the preparative method for white lime nitrogen was found to be most suitable. The best condition was to mix $CaCO_3$ and quick lime in the ratio of 1 : 1.3 and heat at 800°C for more than 3 hrs while passing in NH_4 and CO gas. For the preparation of $CaCO_3$ labeled with Ca^{45}, $Ca^{45}Cl_2$ in HCl solution was used as the starting material. It was neutralized with a saturated solution of Na_2CO_3 and the precipitate collected and dried. For the preparation of $CaCO_3$ labeled with C^{14}, $BaC^{14}O_3$ was used as the starting material. $C^{14}O_2$ was evolved by the addition of perchloric acid and absorbed in $Ca(OH)_2$. (M.C.G.)

25800 (AEC-tr-4482(p.1679-91)) STUDIES ON THE PREPARATION OF LABELED LIME NITROGEN AND ITS USE. PART 2. THE UPTAKE OF Ca^{45} IN LABELED LIME NITROGEN BY CROP PLANTS. Shingo Mitsui, Jun Kurihara, Susumu Sonoda, Toru Hirayama, Kazuyoshi Hamada, and Akiro Terakawa.

Studies were made of the uptake and utilization of calcium in lime nitrogen (cyanamide) by wheat grown on the Tanashi volcanic ash soil, which is poor in exchangeable calcium. Ca^{45} was used to label the cyanamide. Samples of the wheat were taken at elongation, headings, and harvest times and analyzed. The Ca^{45} was taken up in considerable amounts and continuously during the entire period of growth. Studies showed that the Ca^{45} was distributed uniformly in the plants. (M.C.G.)

25801 (AEC-tr-4482(p.1692-1700)) THE MEASUREMENT OF THE THICKNESS OF LEAVES USING S^{35}. Yoshio Yamada, Satoru Tamai, and Tadao Miyaguchi.

The thickness of leaves was measured using S^{35} to study the relationship between the thickness and the physiological activity of the plants. The apparatus used in the measurements is described. Rice leaves were used as an example. The thickness of these leaves was found to be smaller at the portion close to the top and to gradually increase toward the bottom. The relationship between the thickness and color of the rice leaves is discussed. (M.C.G.)

25802 (AEC-tr-4482(p.1701-20)) MEASUREMENT OF UNDERGROUND WATER BY USE OF Na^{24}. [T.] Ochiahi, [S.] Kimura, and [T.] Takahashi.

In order to be able to measure underground water in the field without pumping tests, a method of measurement by the use of radioisotopes through small-diameter borings was used. This was used to determine the flow rate of

underground water by measuring the rate of dilution of radioisotopes in borings. In order to determine with a greater precision the range of distribution of underground water and the permeability of water-holding strata, radioactive probes and gamma logging were used. A radioisotope flow meter designed for the measurements is described. Na^{24} was used as the tracer. Underground water measurements at Takaoka, Shizuoka Prefecture, are given as an example. The water flow speed ranged from 5 or 6 cm to 5 m in most of the hilly areas and plateau. (M.C.G.)

25803 (JPRS-7432) MILITARY MEDICAL JOURNAL. Translation of Voenno-Med. Zhur., No. 7, 3-96(July 1960). 158p.

Twenty-eight papers are included on problems in organizing medical care for troops, aviation and naval medicine, problems in therapy and prophylaxis, problems in hygiene and epidemiology, and problems with medical equipment. Separate abstracts have been prepared for 9 papers. (D.E.B.)

25804 THE RADIOACTIVITY OF A NUMBER OF THE HIGHER ALGAE IN THE REGION OF THEODOSIA. O. G. Mironov. Doklady Akad. Nauk S.S.S.R., 138: 686-7(May 21, 1961). (In Russian)

Samples of algae were ashed, and the radioactivity in the ash was determined by counting on a MST-17 end-window counter. A potassium standard was used to convert relative activities to absolute values. The potassium in the ash was determined quantitatively by the cobalt-nitrite method. It was found that the radioactivity in Cystoseira barbata significantly exceeded the natural activity due to potassium. Aluminum absorption studies on the ash of this algae indicated the existence of $Sr^{90}-Y^{90}$ in the ash. A sample of Cystoseira barbata gathered in 1953 was secured from a local museum and analyzed. It showed only the presence of K^{40}. Other samples of Cystoseira barbata from the Sevastopol Biological Station which were gathered in 1939 and 1949 indicated the absence of fission products in the ash. The radioactivity in the ash of the other algae present was due to the presence of K^{40}. (TTT)

25805 A NOMOGRAM FOR CALCULATING AUTORADIOGRAPH EXPOSURES. W. G. Duncombe (Wellcome Research Labs., Beckenham, Kent, Eng.). Intern. J. Appl. Radiation and Isotopes, 10: 212-13(July 1961). (In English)

The nomogram was constructed to permit equalization of exposures and is based on the equation, $e^{-\lambda t} - e^{-\lambda t_2} = e^{-\lambda t_3} - e^{-\lambda t_4}$. The equation and the considerations on which the nomogram is based are discussed. An example of the nomogram is also given. In calculating autoradiographic exposure, exposure should not be prolonged beyond 2 or 3 weeks in order to avoid latent image fading. (P.C.H.)

25806 INTRAGASTRIC BETA IRRADIATION WITH Ru–Rh^{106} IN HUMAN SUBJECTS; RESULTS WITH SINGLE DOSES. Raymond Teplitz, Benum W. Fox, Margaret S. Littman, and Armand Littmand (Univ. of Illinois Coll. of Medicine, Chicago). J. Nuclear Med., 2: 187-99(July 1961).

Six patients were given single treatments with beta radiation of Ru–Rh^{106} from an intragastric point source centered in a balloon inflated with 525 cc of air. Dosage estimated with an especially designed extrapolation chamber ranged from 200 to 1000 rep at the surface of the mucosa. The dosage rate varied from 8.4 to 5 rep/min. With doses of 450 rep and larger, in all but one instance, there was abolition or substantial decrease in basal acid secretion. Histamine or Histalog-stimulated acid output was only questionably and briefly reduced, indicating that there was no real reduction in parietal cell mass. Gross and microscopic anatomic changes were observed even with the smallest doses, 200 rep. These alterations became evident more quickly and were more severe as dosage increased. With doses 600 rep and larger, chronic ulcers of the lesser curvature were observed. The technique of intragastric irradiation is technically feasible and safe, but the single dose method is not satisfactory for reduction of acidity. Fractionated dosage is now being employed in the treatment of selected patients with peptic ulcer and patients with gastric neoplasm. (auth)

25807 TRACER DYNAMICS: II. THE LIMITING PROPERTIES OF THE TRACER SYSTEM. Per-Erik E. Bergner (Karolinska Institutet, Stockholm). J. Theoret. Biol., 1: 359-81(July 1961).

An analysis is presented of the finite tracer system, i.e., the system composed of a finite number of mutually exclusive and uniform compartments or subsystems. Special attention is paid to the limiting properties of that system and to the connection between the tracer and its mother substance. The results of the analysis are summarized in the form of a number of theorems and it is shown that their validity can be extrapolated to the more general tracer system with non-uniform compartments. The consequences of that are briefly indicated. It is shown that the possibility of treating non-uniform compartments seems to imply a simplification of the theory in a case like the closed system of plasma and red blood cells. A fundamental property of the present approach is that the fluxes are expressed as functions of the total amounts and not of the concentrations of the actual substance, and, this indicates an improvement as regards the significance of the observed variables. (auth)

25808 WAVE MECHANICS AND MUSCULAR CONTRACTION. William Arnold (Oak Ridge National Lab., Tenn.). J. Theoret. Biol., 1: 404-6(1961).

Results are presented from calculations of the quantum mechanical forces necessary to develop tension and produce contractions by muscles. It is concluded that the quantum mechanical forces involved in confining an electron, or hole, to a volume corresponding to a molecular weight of 36,000 are able to account for the tension developed by muscle. (C.H.)

25809 CONTRIBUTION FOR CALCULATING THE INTEGRAL DOSE. V. STUDIES ON Co^{60} TELETHERAPY. S. Okajima (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2509-16(1960).

Three existing methods for getting the integral dose in Co^{60} teletherapy were discussed, and then the new calculating method was presented as an improved yet more simple way to get the correct value. Mayneord's method, as well as its modification, gives a smaller than actual value of the integral dose when a small entrance field is used. The method of calculating by energy flux gives a larger than actual value when used for a small entrance field. These two methods give the correct values when the entrance fields are large. Thus a curve between a curve of Mayneord's method and one of the energy flux method is regarded as the reliable one showing the real relationship between the integral dose and the depth of the body from the surface. By multiplying the dose radiated to a field by the area of that field and by the thickness factor (specific integral dose) obtained from the curve, the correct integral dose was obtained simply in stationary as well as in moving therapy. (Abstr. Japan Med., 1: No. 9, 1961)

25810 CALCULATION OF INTEGRAL DOSE BY THE DIRECT MEASUREMENT METHOD. H. Iida (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2568-2661(1960).

The new method of calculating the integral dose for circular or rectangular fields was introduced in accordance with its definition. The value obtained by this method was compared with that by graphic, Mayneord's, and Eto's methods. The dose was measured three-dimensionally by ionization chamber (Victoreen, Radocon, and home-made extrapolation chamber) at a number of points 2 cm apart, in a paraffin phantom, and reliable isodose charts were obtained. The value of the integral dose by the new method was nearly equal to that of the graphic method with charts and was shown to be more real compared to that obtained by Mayneord's or other methods. A desirable feature of the method is that the integral dose is obtained without using the isodose chart in part of the main beam as well as outside of the main beam. (Abstr. Japan Med., 1: No. 9, 1961)

25811 COMPARISON OF RADIOISOTOPE SCANNING WITH CEREBRAL ANGIOGRAPHY AND AIR STUDIES IN BRAIN TUMOR LOCALIZATION. John G. McAfee and David R. Taxdal (Johns Hopkins Hospital, Baltimore). Radiology, 77: 207-22(Aug. 1961).

Results are presented from an evaluation of cerebral scintillation scans in the diagnosis of brain tumors in 400 suspects. Results are compared with those obtained by conventional neuroradiologic methods. It is concluded that the technique of cerebral scanning deserves a place in the evaluation of intracranial tumors and should become a routine part of the investigation of brain tumor suspects following routine skull radiographs and preceding air studies or angiography. (C.H.)

25812 A RADIATION KNIFE. A. I. Serebrov (Inst. of Oncology, Academy of Medical Sciences, USSR). Znanie-Sila, No. 5, 17(1960).

Experiments were conducted on the immunization of animals with cancer tissue, whereupon the body produces antibodies to this tissue. The antibodies, bonded with an isotope, should have an affinity for tumor cells and should be able to penetrate them easily, allowing the isotope to carry out its lethal effect. Encouraging results were obtained in the search for a chemical preparation which will sensitize tumor cells to radioactive radiation, while protecting healthy tissue from the injurious effects of such radiation. (OTS)

25813 METHOD OF DRAWING ISODOSE CURVES FOR ROTATION THERAPY WITH Co^{60}. Julien L. Garsou (Institut Interuniversitaire des Sciences Nucléaires, Brussels). p.67-72 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

From measurements of the dose distribution in horizontal planes in a phantom irradiated normally to its upper plane surface, and after any necessary correction for different curvatures of this surface, the method leads to sets of nomograms which permit a rapid point-by-point determination of the isodose curves by the radiologist. (auth)

25814 ISODOSE CURVES FOR COBALT-60 IRRADIATION. J. Halvas Guerrero (Comisión Nacional de Energia Nuclear, Mexico City). p.73-8 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In Spanish)

A method is described of clinical dosimetry which can be easily applied to the current work of an oncological unit. The source of gamma radiation used is a Theratron B of 1,200 c Co^{60}. (auth)

25815 MANUAL ON USE OF RADIOISOTOPES IN HOSPITALS. Chicago, American Hospital Association, [1958]. 48p.

The text includes articles on the characteristics and medical uses of radioactive isotopes, regulations and procedures, organization and control, facilities and equipment, radiation protection for high energy equipment, administrative, legal, and public relations aspects, and radiation protection education for hospital personnel. A suggested outline for a course in radiation protection is also included. (P.C.H.)

Biochemistry, Nutrition, and Toxicology

25816 (AEC-tr-4482(p.520-37)) DISTRIBUTION OF A FEW TYPES OF RADIOACTIVE SUBSTANCES WITHIN THE BODY AND THE EFFECTS OF EDTA-CALCIUM SALT FOR DECONTAMINATION. S. Okamoto and A. Nukazawa.

The distribution of radioactive materials administered to rabbits by intravenous or intramuscular injection and the effects of EDTA-calcium salt for decontamination were investigated. The progress of daily discharge of radioactive materials in the urine was observed. The discharge was at its maximum the next day after the injection of the radioisotopes. Then it abruptly decreased for a few days. After that it leveled off to a nearly constant degree of discharge. On the day after the injection of EDTA-Ca salt, its effectiveness in removing radioactive materials by discharge was observed. The results of later dissection revealed, however, that the removal caused by a few injections of the salt did not reach a desirable degree. The radioactivity in the urine at the time of dissection was compared with the radioactivity in each internal organ. (M.C.G.)

25817 (AEC-tr-4482(p.538-45)) EXPERIMENTAL RESEARCH ON THE REMOVAL OF CERIUM AND THE PREVENTION OF ITS ACCUMULATION WITHIN THE BODY. K. Kamada, K. Katayama, and S. Beppu.

Results are given of investigations on the effect of various chemicals and certain factors on the removal and prevention of the settlement of radioactive cerium in biological systems. The test animals were rats weighing between 75 and 80 g each. The administration of non-radioactive cerium contributed to the reduction of the concentration of radioactivity in blood, and the reduction of the amount of settlement inside the liver and the bones. The administration of sodium citrate and EDTA contributed to the reduction of the concentration in the blood and settlement in the liver. However, it was not only unable to reduce the settlement in the bones, but results indicated that it might intensify such settlement. It was found that the concentration of radioactive cerium in the blood, liver, and bones is affected by the metabolism of calcium and the calcium content of food. The reduction of the radioactivity in the young animals, which had active metabolism of calcium, was enhanced by taking foods with a high calcium content. If non-radioactive cerium was simultaneously administered, the effect of the reduction was still improved. (M.C.G.)

25818 (AEC-tr-4482(p.546-59)) STUDY OF DISTRIBUTION AND ACCUMULATION OF CESIUM IN MICE BY SINGLE AND CONTINUOUS ADMINISTRATION. M. Izawa, T. Nagai, N. Hoshiko, and Y. Ajiki.

The distribution of cesium in various organs of the body of a mouse was investigated in detail. The time-dependent variation of cesium content was traced, and the biological half-life as well as the absorption rate in each organ was determined. In order to determine the validity of the method adopted by the International Commission on Radio-

logical Protection in which the maximum allowable concentration was computed on the basis of the single-dose experiment, an experiment with the continuous administration of doses was performed. Cs^{134} solution was administered to male mice weighing about 20 grams each. After administration of single doses, the high concentration of Cs^{134} after a few days resided in the muscles, testes, and pancreas. Except during the initial period, the radioactivity in each organ decayed logarithmically, and the half-life was between 5 and 6 days for almost all organs. For the continuous administration of doses, the specific radioactivity increased with the passage of time and reached a constant value within a week. As was the case with the single-dose experiments, the highest concentration of cesium was found in the muscles, and then in the testes. (M.C.G.)

25819 (AEC-tr-4482(p.560-78)) DETOXICATION AND REMOVAL OF RADIOACTIVE STRONTIUM. Y. Ito and S. Tsurufuji.

The behavior of radioactive strontium after its penetration into the body and absorption into the blood was investigated. It was found that a high concentration of chelates and a low concentration of Ca^{2+} in the body fluid is advantageous for the prevention of the settlement of Sr^{90} in the bones. The injection of a large dose of sodium–calcium citrate was extremely effective. A diet with low phosphorus content was effective even with rats not in the period of growth, and it caused discharge of a large amount of strontium. (M.C.G.)

25820 (AEC-tr-4482(p.579-89)) STUDY OF THE PREVENTION OF THE INTERNAL CONTAMINATION BY RADIOACTIVE STRONTIUM. M. Uchiyama.

In order to investigate prevention of contamination of animals by radioactive strontium, experiments were performed on the suppression of absorption of strontium which finds its way into the digestive system, and on the promotion of discharge of strontium which finds its way into the blood stream. Experiments were performed in vitro with small intestines removed from rats, and also in vivo in mice. Sr^{90} was administered and immediately followed by the injection of various chemicals. The reaction of these chemicals to suppress the absorption of Sr^{90} through the intestines was studied. Dihydroxy aluminum aminoacetate was used to promote the discharge of Sr^{90} which found its way into the blood stream. (M.C.G.)

25821 (AEC-tr-4482(p.751-67)) THE FATE OF LEAD IN THE BODY—EXPERIMENT WITH RaD. I. Horiuchi and S. Horiuchi.

To a rat which had already been given lead poisoning by the administration of lead acetate, Pb^{210} was given as a tracer by means of subcutaneous injection, parenteral administration, and inhalatory administration. Subsequently the level of Pb^{210} in the urine and feces was measured daily. The Pb^{210} in the organs and tissues of rats which were bled to death 3 to 20 days after administration of the Pb^{210} was also measured. The isotope concentration was determined in the whole blood, cerebral cortex, lung, liver, and spleen, gastro-intestinal tract, kidneys, muscle, and bones and teeth. It was found that on the 20th day after administration, 5% of the Pb^{210} was absorbed within the body after parenteral administration and 32 and 24% respectively after inhalatory administration and subcutaneous injection. It was observed that most of the absorbed Pb^{210} was accumulated in the firm tissue such as bones and teeth, and very little was found in the soft tissue. (M.C.G.)

25822 (AEC-tr-4482(p.768-75)) THE STUDY ON METABOLISM OF C^{14} LABELED DEXTRAN. I. Nakamura and M. Kogasahara.

Dextran labeled with C^{14} was used in mice, and its metabolism was studied relative to time sequence, with respect to carbohydrate, fat, and protein metabolism in the body. After preparation of the C^{14} dextran from C^{14} sucrose, 0.2 cc of its 6% solution was injected into the tail vein of mice weighing about 20 gm. Then the radioactivity of the lipid, carbohydrate, and protein substances in the body as well as of the excretion was measured on the 2nd, 4th, and 8th day. On the second day the results, expressed in percentage form were: lipid 0.08%, carbohydrate 7.3%, and protein 9.9%. On the fourth day the lipid was 12%, carbohydrate 1.8%, and protein 1.9%. On the eighth day the lipid was 1.4%, carbohydrate 0.3%, and protein 0.2%. The values for the urine and feces on the 2nd, 4th, and 8th days were 66%, 87%, and 94%, respectively. From these results, it was concluded that dextran, in addition to its plasma expanding capacity, has as an additional property the ability to act as a source of nutrition. (M.C.G.)

25823 (AEC-tr-4482(p.799-812)) P^{32} TURNOVER IN THE LIVER AND THE TUMOR OF A CANCEROUS WHITE RAT. S. Taechi and S. Ueda.

A study was made of the nature of malignant tumors with respect to the phosphorus metabolism and in particular relation to the exchange rate of P^{32} in the tumor and liver of a white rat with a malignant tumor. Twenty four hours after the administration of P^{32} by intravenous injection into both a normal white rat and a Yoshida sarcomatous white rat, the highest amount of absorption was found in the bone. The next highest amounts were found in the spleen, liver, tumor, intestines, muscles, lungs, heart, ovaries, and uterus. The amount of absorption of phosphorus in the liver and the tumor of the rat was almost the same. The change in each phosphorus fraction, however, was generally greater in the tumor. (M.C.G.)

25824 (AEC-tr-4482(p.830-44)) STUDY ON STROMAL METABOLISM USING RI (P, S, Ca) IN THE HEALING PROCESS OF A BONE FRACTURE. I. Aoya, E. Ishigami, and T. Yoneda.

An investigation was made of the healing process of a bony fracture mainly from the viewpoint of stromal metabolism. RNA metabolism was most active 8 days after the bony fracture and it was considered to be closely related to the biological protein synthesis within the cell. The peak of chondroitin sulfuric acid metabolism was reached 2 weeks after the bony fracture and coincided with the histological observation. Localization of radioactive sulfur by means of radioautography was observed in the cell as well as in the stroma and was most marked in the undifferentiated cartilage-like cell layer. It gradually became just a trace amount with the loss of metachromasia. The peak of chondroitin-Ca complex metabolism was reached 1 week after the bony fracture. Bony salt metabolism showed improvement from the first week after the bone fracture, reached its peak the third week, and gradually declined. (M.C.G.)

25825 (AEC-tr-4482(p.860-78)) CONTINUED EXPERIMENTAL STUDIES ON THE STORAGE OF IRON WITH Fe^{55} AND Fe^{59}. H. Saito, S. Sugishi, S. Washino, H. Kyotei, Y. Terada, and I. Igami.

Experimental observations were made of hemosiderin and ferritin under various conditions using Fe^{55} and Fe^{59} in an attempt to elucidate the problem of iron metabolism in various clinical disorders. Three mg of saccharated iron oxide per 100 gm weight was injected into a group of rats daily until a total dose of 21 mg per 100 gm was reached. The iron metabolism of hemosiderin and ferritin was more active in the liver than in the spleen. The exchange of iron

was slow when the iron storage was great and active when the storage was small. It was concluded that the metabolic activity of the stored iron is closely related to hemoglobin synthesis. In the stored iron, ferritin showed the most activity. In the mobilization of the stored iron, there was a decrease in hemosiderin and ferritin in proportion to their existing levels. (M.C.G.)

25826 (AEC-tr-4482(p.943-55)) STUDY OF WATER METABOLISM WITH HEAVY WATER AS TRACER, CONTINUED REPORT—INTRA-TISSUE SHIFT OF WATER. T. O. Takai, K. O. Matsumoto, S. M. Nakai, and S. I. Sugino.

An investigation was made of the distribution of heavy water in the tissues when it is given either orally or subcutaneously to a healthy young rat and the tracing of heavy water plasma concentration when administered to a healthy adult. Heavy water was given to rats and measurements made of the distribution in each organ and tissue 1, 3, 8, and 24 hrs after the doses. It was found that the heavy water disposes quickly and uniformly into the blood and tissues, indicating its usefulness as a tracer for water. Measurements made of the hourly change of heavy water concentration in human plasma showed that it distributes uniformly within an hour. (M.C.G.)

25827 (AEC-tr-4482(p.1598-1606)) STUDIES ON THE IMPROVEMENT OF PHOSPHORUS FERTILIZER DRESSING IN MULBERRY FIELDS. THE UPTAKE AND UTILIZATION OF SPRING TOP-DRESSED PHOSPHORUS FERTILIZER IN ALLUVIAL SOIL-MULBERRY FIELDS. Nobuyuki Nori.

Field experiments in alluvial soil of mulberry fields were carried out in order to study the uptake of the top-dressed phosphorus fertilizer given in the spring and summer, and to investigate the use of radioactive calcium superphosphate. The layout and dressing method are shown. The absorption and fixation ability of the phosphate was weak and the phosphate moved rather easily. From the results it was concluded that the usual dressing of superphosphate fertilizer in the spring is almost useless. (M.C.G.)

25828 H^3 INCORPORATION INTO ASCITES TUMOUR AND TISSUE CULTURE CELLS EXPOSED TO SYNKAVIT AND ITS TRITIATED ANALOGUE. Iremlin Simon-Reuss (Cambridge Univ., Eng.). Acta Radiol., 56: 49-56(July 1961). (In English)

Autoradiographic studies of living normal and malignant cells show a rapid incorporation of the tritium of the tetrasodium 2-methyl-1:4-naphthaquinol (6-T) diphosphate into the cells. A selectivity of uptake by the tumor cells measured by grain counts was demonstrated. (auth)

25829 THE ULTRASTRUCTURE OF THE KIDNEY IN LEAD INTOXICATION WITH PARTICULAR REFERENCE TO INTRANUCLEAR INCLUSIONS David L. Beaver (Washington Univ. School of Medicine, St. Louis). Am. J. Pathol., 39: 195-208(Aug. 1961).

The specific effect of inorganic lead upon the rat kidney was apparently limited to the cells of the proximal convoluted tubules, where its major pathologic manifestations were the production of intranuclear inclusions and degenerative changes in the cytoplasm. With chrome-osmium fixation, the inclusion ultrastructurally consisted of 3 portions, viz.: a compact core; a looser, beaded, filamentous periphery; and scattered electron-dense particles. Metallic or ionic lead could not be demonstrated, and the inclusion developed independently of the nucleolus. Electron microscopically, the inclusion produced by lead was quite different from intranuclear inclusions of viral origin, which usually are associated with infective particles. (auth)

25830 HEAVY WATER INHIBITION OF CELL DIVISION: AN APPROACH TO MECHANISM. Paul R. Gross and William Spindel (New York Univ., New York, Rutgers Univ., Newark, N. J., and Marine Biological Lab., Woods Hole, Mass.). Ann. N. Y. Acad. Sci., 90: 500-22(Oct. 7, 1960).

At concentrations higher than about 75%, deuterium oxide blocks cell division in the eggs of the sea urchin Arbacia punctulata and in those of the annelid Chaetopterus pergamentaceus. The block is reversible, although cells that have been kept in a deuterium-rich medium for long periods relative to the time for one mitotic cycle may show multipolar and irregular divisions after removal to normal water, and may subsequently cytolyze. The antimitotic action is manifested at all stages of the mitotic cycle and, to a significant extent, during cytokinesis. An important feature of the mitotic block is that it becomes effective almost immediately after the cells are placed in D_2O and is quickly reversed when the cells are washed free of D_2O. Whereas D_2O blocks mitosis at all stages it does not destroy the achromatic apparatus, nor does it cause wholesale regression of cleavage furrows. Instead, it exerts a powerful stabilizing effect upon these structures. This appears to be related to a sharp and reversible increase in cytoplasmic viscosity evoked by immersion of nondividing cells in D_2O. Examination of a number of alternative explanations of the effect leaves as the most useful working hypothesis a rigidification of the mitotic apparatus, possibly through a small increase in the strength of individual hydrogen bonds which cross-link macromolecules or small particles. For large, multiply cross-linked structures, such changes for individual bonds would produce very large cooperative effects in the direction required by the data. (auth)

25831 THE RADIOIODINE TEST WITH 0.5 μC OF ^{131}I AS A STANDARD METHOD. W. Schumacher and D. Frost (Städtischen Rudolf-Virchow-Krankenhaus, Berlin). Atompraxis, 7: 249-55(July 1961). (In German)

A standard method for carrying out the radioiodine test with a 0.5 μc of I^{131} is described. The technical prerequisites of the method are explained in physical terms. The results are tested in regard to their information content for differential diagnosis, and a calculated example is given to show that a reduction in the amount of activity does not decrease diagnostic reliability. The gonad dose is 1 mrem, which is less than 1% of the yearly natural radiation dose. (auth)

25832 PERMEATION OF RADIOIODINE (^{131}I) THROUGH THE WALL OF AN ISOLATED RABBIT BLADDER. O. Andrysek and O. Schück (Charles Univ., Prague). Atompraxis, 7: 261-3(July 1961). (In German)

The resorption of I^{131} through the wall of an isolated rabbit urinary bladder was studied, together with certain factors influencing resorption. Resorption was traced by continuous registration of activity in the liquid surrounding the bladder. The results showed that I^{131} can permeate not only the mucous membrane of the bladder, as was found in experiments in vivo, but also the muscle layer of the bladder. The resorption cannot be affected by heat, in contrast to the experiments in vivo. Distension of the bladder accelerates the resorption of I^{131}. Changes in the concentration gradient were found to have no uniform effect on resorption. (auth)

25833 AN ABNORMAL SERUM COMPONENT IN EXPERIMENTAL POISONING BY CADMIUM AND OTHER METALS. D. J. Lawford (London Hospital). Biochem. Pharmacol., 7: 109-22(July 1961).

An abnormal serum component was observed 24 hr after

administration of a single dose of cadmium to albino rats by intraperitoneal injection, which gradually disappeared from the serum over a period of 9 days. The component was not observed on starch gel electrophoresis following very high or very low dosage, the optimum level being found to be 1 mg/kg of cadmium. The rate of migration of the material was not affected by the addition of CaEDTA to the system or the use of a more acid buffer. Ammonium sulphate fractionation showed that the abnormal serum component was precipitated at between 35–40% saturation. The in vitro addition of cadmium to samples of serum in varying concentrations revealed progressive alteration in the migration rate of the albumin band, but indicated no line comparable with the abnormal serum component. The production of varying amounts of the component was observed following the injection of other metals, and mercury appeared to give a stronger line than cadmium, whereas lead gave no band at all. The component was isolated from cadmium-poisoned rat serum in a reasonable state of purity, by means of neutral salt fractionation and zone electrophoresis. An antiserum to the purified material was prepared in rabbits, and after suitable treatment, this antiserum was used to show the presence of the abnormal component in rat serum following very low intraperitoneal doses of cadmium. (auth)

25834 ACCELERATION OF THE EXCRETION OF YTTRIUM, CERIUM, AND LEAD FROM THE BODY WITH THE AID OF ETHYLENE-DIAMINE-TETRAACETIC ACID, DIETHYLENETRIAMINE-PENTAACETIC ACID AND THE DIAMINODIETHYL ESTER OF TETRAACETIC ACID. I. P. Tregubenko, V. G. Yashunskii, and D. I. Semenov (Inst. of Biology, Academy of Sciences, Sverdlovsk, USSR and All-Union Research Chemopharmaceutical Inst., Moscow). Biochemistry (U.S.S.R.) (English Translation), 26: 154-63(July-Aug. 1961).

The diaminodiethylester of tetraacetic acid(DDTE), diethylenetriaminepentaacetic acid-(DTPA), and ethylenediaminetetraacetic acid (EDTA) were tested for accelerating the elimination of Y, Ce, and Pb from the body. With regard to Y and Ce the chelates can be arranged in the following series of decreasing efficacy both with early and delayed use: DTPA > DDTE > EDTA, and with regard to lead: DTPA > EDTA > DDTE. Following DDTE and DTPA injection increased elimination with urine and feces of Y and Ce, but not of Pb, lasts several days. DTPA should be particularly efficient with regard to metals which are mostly deposited in the liver. With delayed use of the chelates the calcium displacing constants ($K_{d[Ca]}$) correlate well with the absolute amount of the metal eliminated in the urine but not with the relative increase in its elimination. It seems justified therefore to extend the hypothesis of the relationship between ($K_{d[Ca]}$) and chelate efficacy from early to delayed use of these compounds. A theoretical interpretation is presented of the differences in the efficacy of the above chelates. (auth)

25835 THE DISTRIBUTION OF RADIUM IN HUMAN BONE. Elizabeth Lloyd (Churchill Hospital, Oxford). Brit. J. Radiol., 34: 521-8(Aug. 1961).

The distribution of α tracks in microscopic volumes of the long bones of three cases of radium poisoning shows that the α activity was mainly found in the Haversian systems of the two patients who received their radium at the ages of 32 and 47, while in the patient who ingested her radium at the age of 17, most of the activity was found in a subperiosteal layer of bone. In this patient the hot spots accounted for about 12% of the volume of the sections studied. This was about four times greater than in the other two cases. The highest concentration of α activity was, however, found in the patient with the highest body burden, in a plugged Haversian system. The number of Haversian systems associated with high intensity α activity in this patient was, however, small and only 3% of the hot spots counted over the section has a concentration of α activity greater than half the maximum intensity. The non-uniformity factors for the three cases were found to be in the range 13 to 40, a range which also covers two cases previously studied. The corresponding non-uniformity factor for the hypothetical deposition of Sr^{90} in the Ra^{226} sites has a maximum value of 6, corresponding to the sub-periosteal activity in one case. The maximum dose-rates from the observed concentrations of radium in the hot spots of the three cases have been calculated for different structures in bone. The quantization of α radiation and its implications, as opposed to the calculation of mean dose, are also discussed. (auth)

25836 ELECTRON SPIN RESONANCE SPECTRA OF RIBOFLAVIN AND ITS COMPLEXES. Miriam Sidran (Oak Ridge National Lab., Tenn. and Staten Island Community Coll., N. Y.). Compt. rend. colloq. ampère, 9e colloq., Pise, 1960, p.283-96. (In English)

The electron resonance spectrum of riboflavin-5-phosphate and that of its complexes with tryptophan and serotonin was observed. In general, the spectra were of the gaussian form, with a beam length of about 25 gauss, and a g factor of 2.0040 ± 0.0001. It was apparent that the signals were induced by light with intensities which are dependent on the presence of air and water. During a period in darkness following light irradiation, the signals decrease slowly to approximately 10% of the initial value at the end of four weeks. It was shown that the behavior of these systems in the presence of air is similar to that of the free radicals FMN in solution in the presence of oxygen. The signals observed can not be attributed to the triplet state of the riboflavin complexes, since this would cause broad signals of approximately 400 gauss. Two other possibilities are suggested, namely that the spectrum is due to free radicals or to photoconductivity effects. (tr-auth)

25837 EFFECT OF THYROTROPHIN ON THE METABOLISM OF IODIDE^{131} IN THE THYROID GLAND. Shigenobu Nagataki, Kazuo Shizume, and Shigeo Okinaka (Tokyo Univ.). Endocrinology, 69: 199-209(Aug. 1961).

Iodide^{131} and PBI^{131} in the arterial and thyroid venous blood obtained by catheterization in 28 dogs was measured to study the effect of TSH on the release and uptake of iodide^{131}. When the glandular organic iodine was labeled by the injection of I^{131} prior to the experiments, release of iodide^{131} by TSH was far more intense than that by KSCN, even if the T/S ratio was decreased to less than 50% of the initial value by the injection of KSCN. On the contrary, the release of iodide^{131} by TSH was only temporary and definitely smaller than that by KSCN when all of the I^{131} in the thyroid was kept in the form of iodide by the administration of methyl mercaptoimidazole. The ratios of iodide^{131} to PBI^{131} in the thyroid venous output were compared with the ratios of iodotyrosine^{131} to iodothyronine^{131} in the thyroid gland. Whether TSH was given or not, both ratios were equal when methyl mercaptoimidazole was injected to prevent the reutilization of iodide; when methyl mercaptoimidazole was omitted, the latter was greater than the former. The rate of organic binding of iodide^{131} was calculated from the output of iodide^{131} and PBI^{131}, and the ratio of iodotyrosine^{131} to iodothyronine^{131}. It was shown that the organic binding of iodide^{131} was accelerated within a few minutes after the injection of TSH. From these experiments, it is

concluded that in the physiologic state, iodide is always produced from thyroglobulin in the thyroid, but it is not discharged from the gland because the capacity for organic binding of iodide exceeds the iodide production. Both proteolysis of thyroglobulin and organic binding of iodide are accelerated within a few minutes when 50 to 2000 U.S.P. milliunits/dog of TSH is given. However, in the initial phase of its action the rate of iodide production from iodotyrosine exceeds the rate of organic binding of iodide, and this results in the release of iodide from the thyroid gland in addition to PBI. The thyroid gland starts to accumulate iodide several hours later, since the increase proteolysis of thyroglobulin terminates, as judged from the output of PBI, while the increased rate of organic binding continues. (auth)

25838 PRECISION PLATING OF STEARIC ACID-1-CARBON-14 FROM BENZENE SOLUTIONS. M. C. Kordecki and M. B. Gandy (Georgia Inst. of Tech., Atlanta). Intern. J. Appl. Radiation and Isotopes, 10: 210-12(July 1961). (In English)

A quick and precise method of counting benzene solutions of stearic acid with a thin end-window Geiger counter was required. During a given series of analyses, either Teflon discs or watch glasses were used, however, a solution plated on Teflon gave higher counts. A table is given of samples of radiostearic acid plated from benzene solutions. (P.C.H.)

25839 A REVIEW OF EXPERIMENTAL WORK ON RADIO-YTTRIUM COMPRISING: 1. THE TISSUE DISTRIBUTION, 2. THE MECHANISM OF DEPOSITION IN BONE, AND 3. THE STATE IN THE BLOOD. Eileen N. Ramsden (Churchill Hospital, Oxford). Intern. J. Radiation Biol., 3: 399-410(July 1961).

Literature covering the deposition of injected radioyttrium in soft tissues and bone is reviewed. When injected in a carrier-free form, yttrium is a bone-seeking isotope. In the presence of carrier, aggregates of larger particle size are formed, and these show greater affinity for the soft tissues which have the highest proportion of reticuloendothelial cells. The effect of chelating agents is to render the yttrium more soluble, thus increasing excretion; they reduce the extent of colloid formation and reduce the size of the colloidal particles formed. Contradictory reports as to the site of deposition of yttrium are discussed. (auth)

25840 STUDIES ON THE DISTRIBUTION AND PHOSPHATE TURNOVER OF THE ACID-SOLUBLE PHOSPHORUS COMPOUNDS IN VARIOUS NORMAL AND NEOPLASTIC TISSUES OF RATS. I. A SEMI-MICRO GRADIENT ELUTION CHROMATOGRAPHY WITH DOWEX FORMATE AND IDENTIFICATION OF SOME PHOSPHATE ESTERS ON THE CHROMATOGRAM (ENGLISH TEXT). S. Horie and S. Terada (Tokyo Univ.). J. Biochem. (Tokyo), 47: 335-50(1960).

A modified semi-micro gradient elution chromatography for the analysis of tissue acid-soluble phosphorus compounds is described. One to 3 g of tissue can be analyzed by this method. Liver, muscle, and thymus tissue of rats were analyzed and the chromatograms are illustrated. The distribution and turnover of the acid-soluble phosphorus compounds in rat liver were also studied by P^{32} injection and the use of the semi-micro method. Glucose 6-phosphate and L-α-glycerophosphate were identified on the chromatogram, and a phosphorus compound containing aminoacid was separated from the dowex 1 formate non-adsorbable fraction. (Abstr. Japan Med., 1: No. 9, 1961)

25841 STUDIES ON THE DISTRIBUTION AND PHOSPHATE TURNOVER OF THE ACID-SOLUBLE PHOSPHORUS COMPOUNDS IN VARIOUS NORMAL AND NEOPLASTIC TISSUES OF RATS. II. COMPARISON OF THE CHROMATOGRAMS OBTAINED WITH VARIOUS TISSUES INCLUDING TUMOURS (ENGLISH TEXT). S. Horie (Tokyo Univ.). J. Biochem. (Tokyo), 47: 429-44(1960).

Using a modified semi-micro gradient elution method of chromatography, the distribution of the acid-soluble nucleotides in various normal and neoplastic tissues of rats was compared and the variations of the distribution are described. The distribution and phosphate turnover of the acid-soluble phosphorus compounds were also studied by intraperitoneal injection of P^{32} followed by the chromatographic analysis. The distribution patterns of nucleotides and radioactivity in liver, muscle, heart, lung, thymus, spleen, testicles, brain, fetal liver, and experimental hepatomas are illustrated and the differences between these tissues were pointed out. The characteristics of the experimental hepatoma tissue as compared with the normal liver tissue are as follows: The concentration of oxidized DPN was low; the incorporation of P^{32} inorganic phosphate into glucose 6-phosphate and L-α-glycerophosphate was absent or, if any, very low; radioactivity of inorganic phosphate in the total acid-soluble radioactivity was extraordinarily high as compared with other tissues besides the liver tissue. (Abstr. Japan Med., 1: No. 9, 1961)

25842 EFFECT OF BOILING AND OF CYANIDE ION ON SERUM BINDING OF Co^{60} VITAMIN B_{12}. Robert W. Bertcher, Leo M. Meyer, Claire W. Mulzac, and Inez F. Miller (South Nassau Communities Hospital, Oceanside, N. Y.). J. Nuclear Med., 2: 200-3(July 1961).

Heat denatured serum protein may bind Co^{60} vitamin B_{12} at least as avidly as does native protein. Boiling frees vitamin B_{12} from protein binding in proportion to its duration; complete physical separation of vitamin and protein is achieved after four hours. Cyanide ion in low concentration has no direct effect on the protein–vitamin B_{12} bond. (auth)

25843 EFFECTS OF HEAVY WATER ON POLIOVIRUS MULTIPLICATION: RESULTS AND SPECULATIONS ON MECHANISM. David Kritchevsky, Richard I. Carp, and Hilary Koprowski (Wistar Inst. of Anatomy and Biology, Philadelphia). Nature, 191: 250-1(July 15, 1961).

The CHAT strain of type I polio virus was grown on monkey kidney cell monolayers maintained in normal growth medium, in deuterium oxide, and irradiated by 300 r of x radiation. Duplicate cultures were kept at 35 and 40°C. Preliminary observations indicated the effect of deuterium oxide on plague size is more pronounced than that of x rays. Different plaque ratios were obtained for virus grown in deuterium oxide at 37 and 40°C. Mechanisms by which deuterium oxide influenced virus growth appeared to involve the extent of randomization of the virus structure and to be manifest either by altering the stability of the hydrogen bonding in the molecule or by affecting the transition temperature of the helix-random coil transformation. (C.H.)

25844 ESTIMATION OF TIME OF GENERATION OF LIVING CELLS. R. J. M. Fry, S. Lesher, and H. I. Kohn (Argonne National Lab., Ill.). Nature, 191: 290-1(July 15, 1961).

Tritiated thymidine was used as a labeling agent in the determination of generation time and mitotic time of the labeled cells and generation time of unlabeled cells in mice. Radioautograms were made of tissues taken at intervals up to 16 hr after administration of thymidine. Data are presented graphically and results are discussed. (C.H.)

25845 ASSESSMENT OF CHRONIC EXPOSURE TO RADIOSTRONTIUM BY URINARY ASSAY. C. L. Comar and Jay Georgi (Cornell Univ., Ithaca, N. Y.). Nature, 191: 390-1(July 22, 1961).

Urinary analysis is recommended as a means of assessing chronic exposure to radiostrontium. Data are tabulated on the Sr–Ca relationship between diet and urine of rats and humans. The advantages of using urinary assays are outlined. (C.H.)

25846 LIPOPHILIC COLLOIDS OF YTTRIUM-90: PREPARATION AND TISSUE LOCALIZATION IN ANIMALS FOLLOWING I. V. ADMINISTRATION. R. J. Speer and William R. Whigham (J. K. and Susie L. Wadley Research Inst., Dallas and Baylor Univ. Graduate Research Inst., Dallas). Proc. Soc. Exptl. Biol. Med., 107: 495-8(July 1961).

Two new lipophilic colloids of radioyttrium, yttrium-oleoylacetone chelate-Y^{90} and yttrium-dodecyliminodiacetic acid chelate-Y^{90}, were prepared. Their tissue deposition in experimental animals following i.v. administration was shown to compare closely with that of the more common inorganic, hydrophilic radiocolloids. Lipophilic character appeared to confer on these products no unique tissue distributional behavior. (auth)

25847 INTERRUPTED ENTEROHEPATIC CIRCULATION OF BILE AND ITS EFFECT ON URINARY AND BILIARY EXCRETION OF I^{131}. Quentin L. Hartwig (Louisiana State Univ., New Orleans). Proc. Soc. Exptl. Biol. Med., 107: 502-5(July 1961).

Total biliary diversion markedly depressed urinary excretion of I^{131} intravenously administered. The effect was apparent within 2 hr post choledochostomy. Fasting reduced urinary excretion of I^{131} to a minor extent; operative trauma had no effect. Treatment of bile fistula rats with donor bile and/or iodinated drinking water significantly increased I^{131} excretion. I^{131} content of bile was significantly reduced in bile fistula rats only through combined treatment with donor rat bile and iodinated drinking water. I^{131} content in urine paralleled that of sodium under some conditions but not in others. (auth)

25848 TETRACYCLINE ACCELERATES ELIMINATION OF STRONTIUM FROM BONES IN MICE. Victor Richards, Jerold M. Lowenstein, John W. Phillips, and Constance Armitage (Presbyterian Medical Center, San Francisco). Proc. Soc. Exptl. Biol. Med., 107: 550-1(July 1961).

The antibiotic tetracycline was found to accelerate the elimination of Sr^{85} from the bones of mice, while not significantly affecting the amount deposited in bones. Data are tabulated. (C.H.)

25849 APPARATUS AND TECHNIC FOR THE ADMINISTRATION OF INTRACAVITARY RADIOACTIVE ISOTOPES. Normand J. Michaud and Leonard M. Liegner (St. Luke's Hospital, New York). Radiology, 77: 292-4(Aug. 1961).

The method of administration of radioactive isotopes in the treatment of pleural effusions and ascites associated with cancer will vary according to the therapeutic technic. A procedure with a suitable apparatus that utilizes an economical and sterile disposable package is described. The radioactive isotope, whether colloidal chromic phosphate (P^{32}) or colloidal gold (Au^{198}), can be obtained in the exact amount prescribed. The entire apparatus is assembled within a few minutes under sterile conditions. Before the hypodermic needles are inserted into the radioactive isotope vial, the air is removed from the tubing by the flow of saline in each segment. Each section is then clamped. The shielded radioactive isotope is then placed on a table or stand and the rubber seal of the vial is swabbed with alcohol or iodine. The inflow needle is inserted just through the rubber stopper and the outflow needle is inserted to the bottom of the vial. This procedure is carried out without removing the vial from the lead container. (auth)

25850 MINERAL METABOLISM. AN ADVANCED TREATISE. VOLUME 1, PART A. PRINCIPLES, PROCESSES, AND SYSTEMS. Cyril L. Comar and Felix Bronner, eds. New York, Academic Press, 1960. 421p.

The dynamic and functional aspects of mineral metabolism are reviewed. Topics discussed include homeostasis in mineral metabolism, cybernetic aspects of homeostasis, thermodynamic principles and concepts, chelation reactions, methods of kinetic analysis, ion transport, body fluid dynamics, intestinal absorption and excretion, renal excretory mechanisms, and extrarenal regulation with special reference to the sweat glants. Lists of references and author and subject indexes are included. (C.H.)

Radiation Effects on Living Tissues

25851 (TID-13215) AEC MICROBEAM PROJECT FINAL REPORT FOR TEN-YEAR PERIOD ENDING MARCH 31, 1961. Raymond E. Zirkle (Chicago. Univ.). July 28, 1961. Contract AT(11-1)-115. 14p.

The Microbeam Project was undertaken because partial-cell irradiation appeared to have potentialities as a means gaining information about mechanisms of biological effects of radiation, and as an aid in analysis of normal functions of cell parts. Results obtained over a 10-yr period are reviewed. Results of partial-cell irradiation including chromosome paling, chromosomal stickiness, inactivation of kinetochores, and destruction of the spindle and its sequelae are discussed. Cognate studies not involving partial-cell irradiation are reviewed. An annotated list of publications on the project are included. (M.C.G.)

25852 (AEC-tr-4482(p.1250-3)) PATHO-HISTOLOGIC OBSERVATIONS OF VARIOUS MOUSE ORGANS INTERNALLY RADIATED WITH MINIM Zr^{95}. R. Z. Fukunda.

Various effects of minim Zr^{95} on mice, such as body weight changes and patho-histologic change of various organs, are discussed. One to 3 μc of Zr^{95} were injected into the abdominal cavities of mice. An apparent histologic change was recognized in the liver, spleen, and lymph nodes due to the internal radiation of Zr^{95}. Some change in the liver was still observed 2 months later. The lymph nodes and spleen returned to normal in about one month. In bone marrow, in spite of the high value of radioisotope intensity, no marked change was observed except for a slight decrease in all numbers in the epiphyseal portion in an early stage. (M.C.G.)

25853 (AEC-tr-4482(p.1261-70)) EFFECT OF β-RAY EXTERNAL IRRADIATION ON SKIN. K. S. Ohotsuka, M. H. Nakayama, H. Akamatsu, and H. O. Yamashita.

The use of beta radiation in the treatment of superficial skin conditions, particularly in hemangioma simplex and pigmented nevus, is discussed. The progress of skin reaction and its relationship to dosage and number of treatments is reported. Dry dermatitis (erythema, pigment deposit, and exfoliation) and moist dermatitis (ulceration and blister formation) were the main reactions appearing in 1 or 2 weeks following irradiation. No difference in radiation dose was recognized between excellent and unfavorable progress. For prevention of unfavorable progress, it was found to be better to avoid repeating the irradiation more than 6 times. Guinea pigs are also being used to investigate the effects of beta radiation on the skin. (M.C.G.)

25854 (AEC-tr-4482(p.1271-4)) STUDY ON SKIN PIGMENT CHANGE BY RADIATION. T. J. Kobori, H. T. Kato, O. T. Itto, and A. H. Furuta.

The effects of radiation on the skin pigment were investigated. A theory of melanin formation in the epidermis is presented. Unna-Pappenheim stain and toluidine blue stain were carried out to follow the cause and effect relationship between nucleic acid metabolism and melanin formation. Change of skin pigment by radiation disturbances was found to be due to the change in the basal cell which is responsible for the final stage of melanin formation. Abnormal pigment development in the treatment of hemangioma with P^{32} was found to occur only if the treatment was repeated more than twice. (M.C.G.)

25855 (AEC-tr-4482(p.1295-1312)) STAGES OF DEVELOPMENTAL VARIATION IN RADIATION SUSCEPTIBILITY OF THE SILKWORM SEMINAL GLAND ESPECIALLY LOW HATCHING RATE AND ITS HISTOCYTOLOGICAL AND BIOCHEMICAL PROOF. S. Kogure and M. Nakashima.

Experiments were carried out in which 3000 r of gamma radiation from Co^{60} were administered to a male silkworm at each stage of the fifth instar. After the egg-laying, non-hatched eggs were studied. Unfertilized eggs appeared in over 60% of the irradiated series at the early stage and the incidence decreased with the progress of time. At the end-stage of the fifth instar, the incidence was not much different from that of the non-irradiated series. Incidence of dominant lethal eggs reached a peak with radiation at the midstage of the fifth instar, showed almost the same incidence at an early stage, but decreased definitely at end-stage. Predominance of anuclear-spermatozoa and nuclear-spermatozoa under a certain level are considered to be responsible for introducing infertile eggs. Abnormalities in the chromosome in metaphase appeared to have some connection with the emergence of dominant lethal eggs. (M.C.G.)

25856 (AEC-tr-4482(p.1313-18)) STUDIES OF THE GROWTH INHIBITION OF ASCARIS EGGS BY GAMMA RAYS OF Co^{60}. T. Chitani, M. Kondo, and H. Katsuro.

An attempt was made to determine the preventive dose for the ascaris infection. Unicellular eggs of ascaris of pig were irradiated with gamma radiation from Co^{60} and then cultivated at 30°C. The growth during a period of 29 days after irradiation was studied. The growth inhibitory effect of the radiation became greater with the increase of the radiation dose, and above 135 Kr, practically no development of larvae was observed. The radiation dose necessary for the 50% inhibition for the development of larvae was 70 Kr. (M.C.G.)

25857 INDIRECT RADIATION EFFECTS AND DIFFUSIBLE FACTORS IN IRRADIATED TISSUES (STROMATEX). B. Jolles, M. Remington, and I. Simon-Reuss (General Hospital, Northampton, Eng. and Cambridge Univ., Eng.). Acta Radiol., 56: 57-64(July 1961). (In English)

The interplay of irradiated and normal tissues and the role of diffusible substances in the radiation-induced inflammatory reaction are discussed. The time at which the maximum yield of biologically active material is obtained from irradiated skin has been established in experiments with vital dyes injected into the animals at varying intervals after irradiation. The technique of perfusion of rabbits' skin is described and the results of tests on mitotic inhibition in tissue cultures of chick and mouse fibroblasts by perfusates from irradiated skin and normal skin of the same animals are given. (auth)

25858 GENETIC HAZARDS OF RADIATION TO MAN. PART I. Paul de Bellefeuille (Univ. of Ottawa). Acta Radiol., 56: 65-80(July 1961). (In English)

Experimental, clinical, and epidemiological data which have a bearing on the definition of the genetic risk to man from ionizing radiations are reviewed. Through a new analysis of the official Report of the U. S. Commission of inquiry in Hiroshima and Nagasaki, based on a consideration of the irradiation of each parent separately, the probability of a harmful genetic effect in the first generation born to persons exposed to the atomic bombs in 1945 is demonstrated. The total effect, as manifested by altered sex-ratio, congenital malformations, and peri-natal mortality, is significant even when one considers only the exposure of fathers, in whom somatic changes cannot contribute to the observed effect. Autopsy evidence for the teratogenic effect of atomic radiations is also reviewed. (auth)

25859 HETEROSIS AND TESTIS X-IRRADIATION. R. Rugh, H. Funk, and M. Wohlfromm (Brookhaven National Lab., Upton, N. Y.). Atompraxis, 7: 243-8(July 1961). (In English)

CF1 white and C57 black mice, and their hybrids, were tested against 200 and 400 r x radiation to determine whether heterosis extended beyond mere survival to organ tolerance, of the testis. It was found that the reaction of the hybrid testis to x rays was similar to that of the more resistant strain (CF1) and therefore the response was more in the nature of dominance than of heterosis. However, the C57 strain is so radiosensitive that the fact of no increased sensitivity of the hybrid (when the deleterious C57 genes were present) is in itself significant. (auth)

25860 EFFECTS OF LOW DOSE RADIATION UPON MAZE LEARNING OF THE NEONATE RAT. S. J. Kaplan, C. S. Harris, and W. H. Melching (Texas Technological Coll., Lubbock). Atompraxis, 7: 259-61(July 1961). (In English)

Thirty-five albino rats radiated during the first day of life were exposed to 100 r of whole-body x radiation. All Ss were tested at 30 days of age. Compared with 29 controls, the radiated Ss were found to be inferior in terms of error scores but not time scores. It is conjectured that either the earlier age at time of testing, the different maze, and/or the lower dose may account for the lack of evidence of time score differences. Differential sex reactions to radiation were examined but no consistent differences were obtained. (auth)

25861 RECOVERY OF DEOXYRIBONUCLEIC ACID SYNTHESIS IN ULTRAVIOLET-LIGHT-EXPOSED BACTERIA. C. A. Doudney (Univ. of Texas, Houston). Biochem. Biophys. Research Communs., 5: 410-15(Aug. 23, 1961).

Studies of the effects of chloramphenicol on induced mutation and on nucleic acid synthesis in synchronized cultures of Escherichia coli exposed to ultraviolet light demonstrated that a relation exists between the amount of postirradiation RNA which has been synthesized at the time of chloramphenicol addition and the relative rate of DNA synthesis in the presence of chloramphenicol. These studies were extended to log phase cultures of E. coli strain B/r, and experimental results are described which suggest that the recovery of cellular capacity for DNA synthesis (involving the synthesis of RNA and protein) is related to the institution of a rate limiting component of the postirradiation DNA synthetic system. The results further show that the presence of chloramphenicol after ultraviolet exposure does not limit the amount of DNA formed as is the case with unirradiated cells. (auth)

25862 THE EFFECTS OF X-IRRADIATION IN SOLUTION ON THE KINETIC, SEDIMENTATION AND FLUORESCENT PROPERTIES OF FLUTAMIC ACID DEHYDROGENASE. S. J. Adelstein and Lorna K. Mee (Cambridge Univ., Eng.). Biochem. J., 80: 406-14(Aug. 1961).

An explicit mathematical statement for the effects of irradiation on the kinetic parameters K (Michaelis constant) and V (maximum velocity) of enzymes is provided. Irradiation of glutamic acid dehydrogenase, in solution, increases K and decreases V for the substrates glutamate and α-oxoglutarate. V is decreased and K is unchanged for the coenzymes diphosphopyridine nucleotide and reduced diphosphopyridine nucleotide (DPNH). The increase in K for glutamate is not associated with a change in the relative inhibitory power of dicarboxylic analogues of glutamate. Irradiation reduces the main protein peak seen in the ultracentrifuge and produces slower sedimenting material. This is consistent with a splitting of the large kinetic molecular unit into sub-units. At very high doses rapidly sedimenting material, presumed to be aggregates, is produced. The decrease in the main component is coincident with a decrease in enzymic activity. Irradiation of the enzyme reduces its ability to enhance the fluorescence of DPNH. This is observed whether wavelength of the exciting light is 365 or 280 mμ. The change observed parallels a decrease in the maximum velocity, V. The increase in K for glutamate is not accompanied by a decrease in the augmented DPNH fluorescence observed on the addition of glutamate to enzyme–DPNH mixtures. The decrease in maximum enzyme velocity is not paralleled by a marked fall in the intrinsic protein fluorescence. It is suggested that the primary action of the aqueous radicals formed on irradiation leads to modification in the tertiary structure of the enzyme with resulting loss in maximum velocity. (auth)

25863 MECHANISM OF THE OXYGEN EFFECT IN CONNECTION WITH THE IRRADIATION OF PROTEINS. T. E. Pavlovskaya and A. G. Pasynskii (Bakh Inst. of Biochemistry (U.S.S.R.) (English Translation), 26: 96-103 (July-Aug. 1961).

The oxidation of thiol groups was investigated on solutions of cysteine and egg albumin and also on dry protein preparations following irradiation with x rays or gamma rays in vacuum, in a nitrogen atmosphere, and in air (at atmospheric pressure and different partial pressures). A number of the experiments was carried out by irradiating in the presence of denaturing substances, namely guanidine, HCl, and others. It was demonstrated that reinforcement of the oxidation of SH groups in the air (the oxygen effect) in cysteine solutions can be qualitatively interpreted by assuming an indirect radiation effect in such a manner that the magnitude of the oxygen effect depends on the relation between the substrate concentration and the applied radiation dose; the oxygen effect diminishes when the ratio expressing this relation drops. In this sense, the magnitude of the oxygen effect is only relative. In protein solutions the magnitude of the oxygen effect depends to a considerable extent on the hydrogen bonds formed by SH groups. In cases of irradiation in vacuum, in a nitrogen atmosphere, or at an air pressure below 100 mm Hg, the SH groups of protein are not oxidized at all as a result of irradiation at doses up to 600,000 roentgens, following irradiation with which complete oxidation of SH groups is obtained in air. If irradiation in vacuum is carried out in guanidine solutions or irradiation takes place in air (at pressures higher than 350 mm Hg), the oxidation of SH groups proceeds normally, just as in solutions of simple thiol substances, which apparently is a result of the breaking of H-bonds in the protein molecule. Addition of air after irradiation of the protein solution does not change the SH-group titer (i.e., an after-effect is absent). An oxygen effect associated with the direct action of radiation apparently cannot be explained by the formation of free peroxide radicals, because the amount of oxidized SH groups exceeds by two orders of magnitude the total number of radicals that has been measured by the electronic paramagnetic resonance method. The concept is advanced that the oxygen effect associated with the direct action of radiation can be explained by the action of irradiated oxygen (present in the O_2^* or O_2^- form) on the breaking and rearrangement of a number of hydrogen bonds in the protein molecule. (auth)

25864 OXIDATIVE CONVERSIONS OF LIPIDS IN IRRADIATED PLANT LEAVES. E. V. Budnitskaya and I. G. Borisova (Bakh Inst. of Biochemistry, Academy of Sciences, Moscow). Biochemistry (U.S.S.R.) (English Translation), 26: 122-7(July-Aug. 1961).

The effect of ionizing radiation on the change in the composition of the free lipid fraction of various plant species, such as bean, pea, and barley, was studied. The results show an appreciable increase in the lipid peroxide content in the leaves of the shoots irradiated with relatively low doses (1000 r). Changes in the composition of unsaturated fatty acids of the free lipid fraction were found within the first hours following exposure to ionizing radiation. Linoleic, oleic, and other unsaturated acids disappear completely from this fraction. Oxidation of plant lipids is caused by the in vivo effect of enzymes since no such increase in lipid peroxides has been noted upon irradiation of the substrates of lipid metabolism (such as linoleic acid, carotene, and lipoxidase), and of leaves in which lipoxidase has been inactivated by steam. (auth)

25865 THE NUCLEOTIDE METABOLISM OF THE BONE MARROW IN NORMAL CONDITIONS AND AFTER IRRADIATION WITH X-RAYS. G. A. Kritskii and F. I. Roitman (Bakh Inst. of Biochemistry, Academy of Sciences, Moscow). Biochemistry (U.S.S.R.) (English Translation), 26: 128-33(July-Aug. 1961).

Changes in the content of acid-soluble purine and pyrimidine compounds and in the intensity of autolysis of nucleic acids in the bone marrow are sensitive reactions to irradiation. These changes may be detected after local irradiation in a dose of 200 r or less. It has been shown that the combination of acid extraction with preliminary homogenization of the tissue in orthophosphate buffer solution in the cold facilitates a more complete extraction of the purine and pyrimidine compounds of the tissue than ordinary acid extraction. (auth)

25866 EFFECT OF IRRADIATION ON HAIR. II. EFFECT OF IRRADIATION IN CONNECTION TO COLOUR OF HAIR (ENGLISH TEXT). T. Adachi and R. Kamata (Tokyo Medical and Dental Univ.). Bull. Tokyo Med. Dental Univ., 6: 139-43(1959).

According to clinical and experimental observations, black hair was most radiosensitive, brown was next, and white hair was most radioresistant. In other words, hair tissue, having the same degrees of growth activities, shows different kinds of radiosensitiveness with differences in color. From the point of regeneration, it was noted that the recovery of growth activity came first and color-forming ability appeared somewhat later. These observations may offer some clues related to the problems of radiobiology and to the physiology of formation of the hair root itself. (Abstr. Japan Med., 1: No. 9, 1961)

25867 EFFECT OF IRRADIATION ON TEETH. II. RADIOGRAPHIC EXAMINATION (ENGLISH TEXT). T. Adachi, T. Murai, and A. Kikuchi (Tokyo Medical and Dental Univ.). Bull. Tokyo Med. Dental Univ., 6: 145-52(1959).

The length of the dentine niche differed after irradiation was given as a single or fractioned dose. The animals (rats) were divided into 3 groups: (A) 600 r for 3 days, (B) 300 r for 6 days, and (C) 150 r for 12 days. No changes were seen 3 days after the exposure. Seven days after irradiation some disturbance of hard tissue formation in the proximal end of the maxillary incisor was seen in groups A and B. Fourteen days after irradiation, these changes were more exaggerated with small tapering of the proximal end of the incisor. Microscopically, such an injured area coincided with a dentine niche. In group C, no niche was formed. Twenty-one days after irradiation, the x-ray shadow of the niche remained approximately the same in group A, with some nuance suggestive of recovery of hard tissue formation. In group C, irregularity in the teeth marrow was progressive. At 35 days after irradiation, there was still appearance of injured dentine in groups A and B, although appreciable signs of recovery were present. Within 47 days after exposure all groups showed an almost complete recovery. It was concluded that the radiographic method is a convenient and easy procedure for observing the hard tissue of the teeth. The soft tissue or cell changes may be adequately studied microscopically. (Abstr. Japan Med., 1: No. 9, 1961)

25868 EFFECT OF TWO SUCCESSIVE APPLICATIONS OF X RAYS ON THE DEVELOPMENT OF NORMAL TISSUES OF CULTIVATED BLACK SALSIFY. Robert Jonard. Compt. rend., 252: 3637-9(June 5, 1961). (In French)

An application of x rays causes an inhibition of the growth of normal salsify tissues; but the tissues later recover a normal growth. A second irradiation causes a more marked inhibition than the first. The enhancement of the radiosensitivity appears to be independent of the dose given at the first irradiation. (tr-auth)

25869 ANALYSIS OF THE EFFECT OF X RAYS ON THE MULTIPLICATION OF A UNICELLULAR CHLOROPHYLL ORGANISM: SCENESDESMUS CRASSUS CHOD. Roland Gilet and Paul Ozenda (Centre d'Études Nucleaires, Grenoble, France). Compt. rend., 252: 3867-9(June 12, 1961). (In French)

The technique of cultures on agar has permitted an analysis on the individual scale of the results previously acquired on populations of unicellular algae in liquid medium. (tr-auth)

25870 EFFECT OF VARIOUS DOSES OF X RAYS ON THE SUCCESS OF INTERRACIAL BREPHOPLASTIC GRAFTS OF OVARIES IN THE MOUSE. Raoul-Michel May and Janine Thimothée (Faculté des Sciences, Paris). Compt. rend., 252: 4204-6(June 26, 1961). (In French)

The favorable effect of x rays on grafts of bone marrow has suggested the application of x rays to interracial brephoplastic ovary grafts. The irradiation, between 600 and 1000 r, of black mice favors the development of intraocular brephoplastic grafts of ovaries on mice of the albino race. The ovaries develop for 35 days but are then invaded by lymphocytes and fibroblasts and totally destroyed near the 43rd day. This degeneracy is perhaps in correlation with the regeneration of producers of antibodies which were destroyed by the irradiation. (J.S.R.)

25871 APPLICATION OF ELECTRON SPIN RESONANCE TO THE STUDY OF FREE RADICALS PRODUCED BY IRRADIATION OF DESOXYRIBONUCLEIC ACID. A. Van de Vorst (Université, Liège), J. M. van der Kaa, J. Depireux, J. Duchesne, and A. J. Bertinchamps. Compt. rend. colloq. ampère, 9e colloq., Pise, 1960, p.297-300. (In French)

The number of free radicals created per gram of desoxyribonucleic acid was studied as a function of gamma dose and radiation output. The curve of the number of paramagnetic centers as a function of dose output shows that a dose output of 27000 rads/hr gives a completely different curve from that obtained with a dose output of 560,000 rads/hr. The paramagnetic centers thus created decrease rapidly after the end of the irradiation to a stable value, but the rate of decrease varies for the two dose outputs. Although the mechanism of this decrease is complex, it is not excluded that it corresponds to free radicals of different types and, consequently, of different lifetimes. (J.S.R.)

25872 CONSTITUTION CHEMICAL CONDITIONS FOR THE EFFICIENCY OF OXYTRYPTAMINE DERIVATIVES IN RADIATION PROTECTION RESEARCH. P. Dukor and R. Schuppli (Dermatologische Universitatsklinik Basel, Switzerland). Experientia, 17: 257-8(1961). (In German)

Mice receiving a lethal dose of whole body irradiation are protected by 5-methoxy-tryptamine or 5-hydroxy-ω-N,N-monomethyltryptamine to the same extent as by serotonin. Other derivatives of oxytryptamine have only slight or no protective properties against irradiation. (auth)

25873 CATECHOL AMINE EXCRETION IN RATS AFTER X IRRADIATION. H. Braun and H. J. Kuschke (Medizinische Univ.-Klinik, Würzburg, Ger.). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed., 94: 827-9(June 1961). (In German)

Total body radiation of rats with doses of 600 and 900 r leads to an increase in the urinary excretion of noradrenaline or noradrenaline and adrenaline. Irradiation with 300 r has no definite effect on catechol amine excretion. (auth)

25874 THE COOPERATIVE PLANT AND SEED IRRADIATION PROGRAM OF THE UNIVERSITY OF TENNESSEE. T. S. Osborne and A. O. Lunden (Univ. of Tennessee Agricultural Research Lab., Oak Ridge). Intern. J. Appl. Radiation and Isotopes, 10: 198-209(July 1961). (In English)

The cobalt-60 plant and seed irradiation facility at the AEC Agricultural Research Laboratory of the Univ. of Tennessee at Oak Ridge is described. The facility, constructed in 1956, provides a source of gamma rays for plant geneticists of the agricultural experiment stations in the southern part of the United States; exposure to reactor neutrons is obtained at the Oak Ridge National Laboratory. Over 500 plant and seed samples, representing about 120 plant species, were exposed to radiation under this program. These samples were submitted by more than 100 research scientists in twenty-two states and five countries. Results are summarized, based on sensitivity in the treated generation for about sixty species of plants. A summary of the observed genetic changes reported for about twenty species is included. A method is described whereby dose-response at maturity may be predicted from seedling performance, following seed irradiation. (auth)

25875 THE RADIOPROTECTIVE ACTION OF PARATHYROID EXTRACT. R. H. Rixon and J. F. Whitfield (Atomic Energy of Canada Ltd., Chalk River, Ont.). Intern. J. Radiation Biol., 3: 361-7(July 1961).

The protective action of a single post-irradiation injection of parathyroid extract in x irradiated rats was confirmed. The effectiveness of the extract (as a difference in survival percentage) was greatest in rats exposed to 800 r. With this dose, the level of protection was maximum and independent of the amount of extract (administered 5 min after

irradiation) between 50 and 200 USP units. The increase in survival obtained with 25 units of extract was about one-half that resulting from the higher doses. The protective action of 200 units was maximum whether injected 5 min or 1 hour after irradiation, but was about one-half the maximum with a delay of 3 hours. The extract was totally ineffective when injected 5 hours after irradiation. A number of lines of evidence suggest the calcium-mobilizing activity of the extract as the most likely basis of its radioprotective action. (auth)

25876 VARIABILITY IN THE OXYGEN EFFECT OBSERVED WITH MICRO-ORGANISMS. PART II. ESCHERICHIA COLI B. Tikvah Alper (Hammersmith Hospital, London). Intern. J. Radiation Biol., 3: 369-77(July 1961).

Post-irradiation conditions of culture are considerably more effective in altering the response of E. coli B to ionizing radiation if it is delivered in anoxic conditions. Thus the oxygen-enhancement ratio depends on conditions of culture, and was found to vary from 1.6 to 3.7. A linear relationship exists between 37% dose and oxygen-enhancement ratio. The inference that radiation causes lethal damage by inflicting at least two different types of injury, one of which is much more affected by the presence of oxygen during irradiation was supported by this. (auth)

25877 THE USE OF AUXOTROPHIC MUTANTS TO STUDY RESTORATION IN ESCHERICHIA COLI B AFTER ULTRA-VIOLET-IRRADIATION. N. E. Gillies (Hammersmith Hospital, London). Intern. J. Radiation Biol., 3: 379-87(July 1961).

To elucidate the mechanism by which cells of E. coli B may be rescued after uv irradiation, mutants with specific nutritional requirements were used, so that certain synthetic pathways could be blocked at will. If mutants requiring an amino acid are incubated for a period after uv irradiation on a medium lacking that amino acid, survival is greatly increased above the level observed when the required amino acid is supplied immediately. Little rescue is observed if the cells are incubated on complete medium for 30 min before the amino acid is withdrawn. There is no rescue of cells which require thymine when thymine is withheld during the initial post-irradiation period. Considerable rescue is observed if all nutrients are withheld for a period after irradiation. The results support the postulate that uv damages at least two sites in the cell. Rapid amino acid metabolism brings to light damage to one of these sites. (auth)

25878 THE PHYSICAL PROPERTIES OF NUCLEOPROTEIN AND DEOXYRIBONUCLEIC ACID FROM X-IRRADIATED THYMOCYTES. J. F. Scaife and P. Alexander (Defence Research Chemical Labs., Ottawa and Chester Beatty Research Inst., London). Intern J. Radiation Biol., 3: 389-98(July 1961).

The investigation was undertaken to see if changes could be observed in the nucleoprotein or nucleic acid of irradiated cells before pyknosis occurred. Suspensions of thymocyte nuclei in water contain approximately 90% of their desoxyribonucleic acid (DNA) as a gel. In 1 M NaCl solution, approximately 50% of the DNA exists as a gel. DNA extracted from irradiated or non-irradiated thymocytes up to three hours after 1000 r at the commencement of incubation, and in which a large proportion of the cells became pyknotic, showed no alteration in its physico-chemical properties. Suspensions of thymocyte nuclei in 1 M NaCl solution showed changes in physico-chemical properties of the gel fractions, which could be correlated with the pyknotic changes in the cells. But there was no indication for changes in the physico-chemical properties of the nucleoprotein before there was pyknosis. There was no alteration in the properties of the soluble DNA of cells even after they became pyknotic. It was deduced that the initial radiochemical reaction that initiates the processes leading to death of thymocytes does not involve the DNA of the cell or that enzymes are released by radiation that attack the DNA. A change in the viscosity of the DNP that swells, but does not dissolve in 1 M NaCl, is noticed concurrently with pyknosis but does not precede it. (auth)

25879 THE MODIFYING EFFECTS OF HYPOTHERMIA AND ANOXIA ON THE X-RAY SENSITIVITY OF THE 4-DAY-OLD CHICK EMBRYO. Ivar Johansen (Norsk Hydros Inst. for Cancer Research, Oslo). Intern. J. Radiation Biol., 3: 411-18(July 1961).

Anoxia affords a high degree of radioprotection for the 4-day-old chick embryo. The dose-reduction factor is about 2. This protection does not depend upon a lowered metabolism, but on a truly anoxic state. The anoxia develops as a result of the consumption of the oxygen present in the egg, and not as a result of a diffusion out of the egg. The critical organ for the radiation damage appears to be the blood vessels. (auth)

25880 SOME EFFECTS OF X-IRRADIATION ON THE METABOLISM OF DEOXYRIBONUCLEIC ACID IN MAMMALIAN CELLS GROWN IN CULTURE. Marie S. H. Dickson and J. Paul (Univ. of Glasgow). Intern. J. Radiation Biol., 3: 419-29(July 1961).

Cultures of strain-L mouse cells were exposed to doses of x irradiation up to 2300 r. Immediately after treatment the incorporation of C^{14}-formate and H^3-thymidine into DNA was depressed, and the degree of this effect was shown to be dependent on oxygen tension. If the cells were allowed to grow for several days after irradiation, mitosis was suppressed, but the synthesis of all constituents, including DNA, continued and resulted in the formation of giant cells. (auth)

25881 DNA-CONTENT OF GIANT CELLS PRODUCED BY IRRADIATION. A. H. W. Nias and J. Paul (Univ. of Glasgow). Intern. J. Radiation Biol., 3: 431-8(July 1961).

The DNA-content of individual strain-L mouse fibroblasts was determined by Feulgen microdensitometry before and after x irradiation. Irradiated cells were found to have greater amounts of DNA and progressively larger values were found with increasing time after irradiation. Values were distributed over a wide range, from the normal post-mitotic content to amounts 29 times greater. The findings indicate that radiation damage is due to the accumulation of many random lesions rather than to one specific lesion. (auth)

25882 EFFECTS OF LOCALIZED DOSES OF HIGH INTENSITY X-IRRADIATION ON THE CARDIOVASCULAR SYSTEM OF THE RAT. Robert A. Baratz, Walter S. Moos, and Roger A. Harvey (Univ. of Illinois, Chicago). J. Nuclear Med., 2: 218-22(July 1961).

Localized doses of high intensity x irradiation produce marked changes in the vascular network of the irradiated area. These changes are severe enough to: be visible on gross examination at autopsy, cause accumulation of RISA in the localized area, and cause a statistically significant loss of RISA from the vascular tree in general, thereby indicating an increase in capillary fragility or permeability. Changes in blood pressure and heart rate in irradiated animals were not significantly different from controls, but this can be accounted for by pressoreceptor reflexes which tend to maintain these parameters at physiologically optimal levels. (auth)

25883 STUDIES ON THE EFFECT OF AURICULAR OR SPLENIC IRRADIATION UPON THE ARTERIAL AND VENOUS BLOOD PICTURE OF RABBITS. M. Yanagi (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho, 55: 38-81 (1959).

Various amounts of x rays were given separately to one side of the auricular and the splenic areas. Changes of the arterial and venous blood withdrawn from the blood vessels of the same site were studied. I. Irradiation of the auricular area. The red blood cell count showed a slight increase in both arterial and venous blood when 100 r was administered. Nevertheless, a slight decrease of the count was noted at 600 r. No appreciable changes, however, were seen in the arteriovenous blood ratio in any irradiation group. White blood cell counts showed a definite increase in each irradiation group in 3 to 6 hours, except for the 600 r group which showed a slight decrease followed by some initial leucocytosis. II. Irradiation of the splenic area. Red blood cell counts decreased more in the venous than in the arterial blood at 20 r. Consequently the arteriovenous blood ratio showed a slight decrease. The count decreased slightly at 50 and 300 r, while the arteriovenous blood ratio showed no significant changes. White blood cell counts showed a more marked increase in the venous than in the arterial blood at 20 r, and the arteriovenous blood ratio decreased. The count markedly increased in the venous blood at 50 r, but the arteriovenous blood ratio showed only a slight alteration. (Abstr. Japan Med., 1: No. 9, 1961)

25884 EFFECT OF X-RAY IRRADIATION ON BLOOD COAGULATION FACTORS IN RABBITS. S. Yoshida (University School of Medicine, Kanazawa, Japan). Kanazawa Irigaku Sosho, 55: 127-51(1959).

Irradiations of 50 r, 300 r, 750 r (LD_{50}), and 1500 r in a single dose were carried out. The number of platelets increased following irradiation of 50 r and decreased with doses larger than 300 r. Single whole-body and abdominal irradiation of 1500 r caused a decrease in the platelet count down to 30000 to 50000 in 10 days and finally death. However, the same irradiation in divided doses resulted in an increase of the platelet count 2 weeks later. Capillary hemorrhages were observed when the platelet count diminished to 30000 to 50000. Coagulation time of whole blood was not altered with 50 r, but was prolonged with doses larger than 300 r. The prolongation reached an abnormal level following single or divided (750 r × 2) whole-body irradiation of 1500 r. According to the thromboplastin generation test, a disturbance of the 3rd platelet factor and a decrease in serum factors were present after a single whole-body irradiation of 1500 r, and a decrease in serum factors after a divided whole-body irradiation of 1500 r. The prothrombin time was prolonged, and the fibrinogen concentration fell following single and divided (750 r × 2) irradiation of 1500 r. (Abstr. Japan Med., 1: No. 9, 1961)

25885 EFFECT OF X-RAY IRRADIATION UPON THE AFFINITY OF BULLFROG'S SCIATIC NERVE TISSUE FOR PROTOPORPHYRIN. III. K. Nakazawa (Mie Prefectural Univ., Tsu, Japan). Mie Igaku, 4: 293-314(1960).

The affinity of porphyrin for the nerve sheath was strong even after a small dose of x irradiation which was previously considered as negligible. The changes of porphyrin affinity were more marked in situ rather than in vitro. Thus the mechanism of the development of nerve damage is explained. (Abstr. Japan Med., 1: No. 9, 1961)

25886 LEUKAEMIA IN THE AkR MOUSE AFTER X-IRRADIATION IN UTERO. Donald Porteous (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Nature, 191: 291-2(July 15, 1961).

Results are reported from an investigation of the incidence of leukemia in mice after exposure of the fetus to small doses of x radiation. Both normal and high-leukemic strains of mice were used. Data are tabulated. Results indicate that the doses of x radiation used had no effect on the incidence of leukemia or on acceleration of the disease in either males or females irradiated in utero. (C.H.)

25887 COMPARATIVE ANALYSIS OF INACTIVATING EFFICIENCY OF RADIATION ON DIFFERENT ORGANISMS. M. Terzi (Università, Pavia, Italy). Nature, 191: 461-3 (July 29, 1961).

Data are tabulated on the dose–effect relationship of radiation and nucleic acid content of a number of organisms. Four different levels, expressing inactivation efficiency, are considered which correspond to four systematically distinct groups. The different degrees of complexity of their genetic structure justify their reaction to ionizing radiations. Levels considered include single-stranded DNA or RNA viruses, double-stranded DNA viruses, bacteria, and cells from vertebrates, including man, and from yeast with ploidy greater than one. (C.H.)

25888 CHROMOSOME REARRANGEMENTS INDUCED BY X-RAYS IN IMMATURE GERM CELLS OF DROSOPHILA. Seymour Abrahamson (Rutgers Univ., Neward, N. J.). Nature, 191: 523-4(July 29, 1961).

Factors influencing the production of chromosome rearrangements by x radiation in early oocytes and oogonia of Drosophila melanogaster are surveyed. Data are tabulated on the frequency of detachments of attached X chromosomes produced by different modes of treatment. The genetic technique used is described and results are discussed. (C.H.)

25889 EFFECTS OF FISSION PRODUCTS ON YOSHIDA SARCOMA CELLS. Y. Masuda (Nippon Univ., Tokyo). Nichidai Igaku Zasshi, 19: 280-95(1960).

The fission products (FP) of uranium were injected into the peritoneal cavity of Yoshida sarcoma implanted rats, and their effects on the division of sarcoma cells were studied. In the case of administration of 50–500 μc of FP, the number of the division of sarcoma cells decreased markedly. The inhibition of cell division was observed mostly 1.5 to 3 hours after the administration. The number of cells at each stage of mitosis was reduced after administration of 500 μc of FP. When less than 500 μc of FP were given, cells in anaphase increased in number. Atypical cells always increased in proportion to the dose of FP. When FP were passed through ion exchange resins and then administered to rats, the inhibitory effects appeared to be somewhat decreased. (Abstr. Japan Med., 11: No. 9, 1961)

25890 HAEMOSTATIC STUDIES ON X-RAY TECHNICIANS. H. Naito (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2266-71(1960).

The effects of x-ray injuries on blood coagulation by general hemostatic tests on 14 x-ray technicians were investigated. Six out of 14 men had experience of more than 10 years, 4 had 5-10 years' experience, and the remaining 4 had less than 5 years. The values of an equal number (14) of normal people were taken as controls. Generally, there was found no statistically significant difference between the technicians and the controls. However, in the technicians there was found a tendency of the serum prothrombin to increase, whole blood clotting time to be shortened, and for the number of platelets to decrease together with a decline in clot retraction. On the other hand, the heparin-like substance tended to increase, especially in x-ray technicians of long-standing experience. (Abstr. Japan Med., 1: No. 9, 1961)

25891 AN EXPERIMENTAL STUDY ON THE EFFECT OF X-RAYS ON THE RED BLOOD CELL SURVIVAL OF IRRADIATED ANIMALS. T. Shioji (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2289-2300(1960).

The survival of red cells of rabbits exposed to single whole-body irradiations of 400 r and 600 r, or exposed to daily whole-body irradiations of 100 r for 6 days, was examined by the Cr^{51}-tagged red blood cell method. When the rabbits were exposed to 400 r, the survival of red blood cells at 2 hours, 15 days, 28 days, 42 days, and 56 days after the exposure showed normal values. When the rabbits were exposed to 600 r, survival of red blood cells at 2 hours, 15 days, and 42 days was normal. When the rabbits were exposed to daily whole-body irradiations of 100 r for 6 days, the life span of red blood cells at 2 hours after exposure was normal, that of red blood cells at 15 days after the exposure was slightly reduced, and that of red blood cells at 42 days after the exposure was shown to be distinctly shortened. (Abstr. Japan Med., 1: No. 9, 1961)

25892 STUDIES ON THE RADIOSENSITIVITY OF FOUR INBRED STRAINS OF MICE. M. Onoue (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2366-79(1960).

The influence of strain, body weight, sex, and age on lethal effects of single whole-body x irradiation was studied in 4 inbred strains of mice maintained in the National Institute of Genetics. Strains used were C57BL/6, A/He, C3H, and C58. All animals at the age of 80 days were exposed to x rays of 560 r, 600 r, 640 r, or 680 r (160 kvp, HVL 0.96 mm Cu, dose rate 71 r/min), respectively. The $LD_{50/30}$ values obtained in each strain were as follows: C57BL/6 584 r, A/He 623 r, C3H 626 r, and C58 634 r. C57BL/6 was the most radiosensitive in terms of the LD_{50} among these strains. Results of irradiation of 680 r (LD_{100}) were as follows: the mean survival days of C3H strains were found to be statistically significantly different from the other strains. In the case of C57BL/6 strains, the death following irradiation was distributed over a longer period than in others, and the frequency distribution curve showed two peaks while the other strains had only one. The percentages of body weight loss were different in each strain, according to their differences of radiosensitivity, but were in linear relation with the dose in each case. From the standpoint of the body weight, the heavier mice seemed to be more resistant than the smaller ones when the results were pooled for all strains. No significant sex differences were indicated in the lethal effects of acute x irradiation. According to the results in two strains of A/He and C3H with doses of 600 r or 680 r, the radiosensitivities were high in younger mice and progressively decreased from 20 to 120 days of age. (Abstr. Japan Med., 1: No. 9, 1961)

25893 STUDIES ON THE RADIOSENSITIVITY OF SO-CALLED DD-MOUSE STRAINS. M. Onoue (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2380-9(1960).

The difference of radiosensitivity among dd-strains from 3 different breeders was studied in connection with the lethal dose of x radiation. In addition, the responses to nembutal (a type of anaesthetic), and the patterns of peripheral white blood cells were studied using the same animals. It was concluded that the variability of response was, in general, smaller in an inbred strain than in a random-bred one. The only exception was the body weight change after irradiation. (Abstr. Japan Med., 1: No. 9, 1961)

25894 EXPERIENCE OF IRRADIATION AT LOWER TEMPERATURES. S. Tarusawa, H. Kato, S. Chiba, and M. Watanabe (Iwate Medical Coll., Morioka, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 18: 2406-15(1960).

The skin to be irradiated was cooled, and the sensitivity to x irradiation was studied. When the shaved back of a rabbit was cooled to 10.7°C lower than normal, radiation was given for 6 minutes. The temperature was still 5.4°C lower than normal at the termination of irradiation. Radiation injury of the skin was slighter than that of the non-cooled skin. When this method was applied clinically to cancer of the tongue and esophagus, it was found to be effective. The injury of the irradiated skin was slight and tolerable, especially for the large amount of 7100 r to which the skin is exposed in the irradiation treatment of cancer of the esophagus. (Abstr. Japan Med., 1: No. 9, 1961)

25895 EFFECT OF IONIZING RADIATIONS ON TISSUE METABOLISM. G. Yokota (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2567-2605(1960).

An inhibition of tissue respiration in rats, caused by single whole-body x irradiation, was most severe in the spleen followed by that in the liver and kidney. The tissue respiration of the cerebral cortex was mostly accelerated. The respiration of the liver, spleen, and kidney cells was more hindered by divided whole-body irradiations than by a single radiation. The whole-body radiation of a small amount of x rays (1 r × 3) inhibited the tissue respiration of the spleen. The x irradiation did not inhibit the tissue respiration of extirpated organs (liver, spleen, kidney). The respiration of the liver cells was strongly inhibited by the x irradiation on the hepatic region. After the single radiation, however, a transient acceleration was observed in a week but none after the divided radiations. The skin tissue respiration of the hepatic region was intensely hindered by the x irradiation of this region. The inhibition of tissue respiration caused by x irradiation was prevented to a certain extent by previous administration of a substance with the SH radical, particularly by cysteine, glutathione and methionine. (Abstr. Japan Med., 1: No. 9, 1961)

25896 EFFECTS OF X-RAYS UPON A SINGLE NERVE FIBRE. H. Kihira (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 46-60(1960).

A single nerve fiber of the bullfrog's sciatic nerve was x irradiated. The action potential was gradually inhibited with an increase of irradiation dose. Less effect was observed in a case of fractionated irradiation, as compared to a single dose. Significant changes in the latent period were not observed after any type of irradiation. (Abstr. Japan Med., 1: No. 9, 1961)

25897 EFFECT OF RADIATION ON THE SEMINIFEROUS TUBULES. C. Shima (Tokyo Medical Dental Univ.). Ochanomizu Igaku Zasshi, 7: 1729(1959).

The effect of irradiation on the testicular seminiferous tubules was investigated. Irradiation caused significant shortening of the tubules. In normal animals sections of the testis reveal that spermatogenesis does not take place uniformly and steadily but in waves. Irradiation caused considerable damage to the spermatogenic cells so that the progress of spermatogenesis was irregular. (Abstr. Japan Med. 1: No. 9, 1961)

25898 HISTOLOGICAL CHANGES OF BRAIN NERVOUS CELLS FOLLOWING X-IRRADIATION OF THE HEAD. H. Tanaka, T. Momose, and K. Zyo (Osaka Univ.). Osaka Daigaku Igaku Zasshi, 11: 1873-7(1959).

The heads of female mice were exposed to x rays (300 to 700 r), and Nissl bodies were examined successively 1, 2, 4, and 10 hours, and 1, 2, 4, 7, 10, and 14 days after irradiation. In the supraoptic and paraventricular nuclei and the giant cells in the autonomic nervous center, there was swelling of nuclei of nervous cells 10 hours after irradiation of 500 r and 700 r, and central tigrolysis 1 day after irradiation. No changes were seen in 300 r irradiated animals. The small

and usual types of autonomic cells and various nervous cells of the cortex and thalamus showed no changes after irradiation by doses in this range. (Abstr. Japan Med., 1: No. 9, 1961)

25899 STUDIES ON THE EFFECT OF γ-IRRADIATION ON THE DIGESTIVE TRACT. III. OBSERVATION ON THE DEATH OF RATS BY LARGE DOSES OF γ-IRRADIATION ON THEIR SMALL INTESTINES. H. Takayama (Osaka Univ.). Osaka Daigaku Igaku Zasshi, 11: Suppl. 2, 5121-5 (1959).

Death in rats irradiated by whole-body Co^{60} γ rays of 1500 r was due not only to the functional disorder of the small intestine, but also presumable to a secondary influence of toxic substances produced in the small intestine. Microscopically, the small intestine after irradiation showed mainly catarrhal changes. The effect of γ irradiation on the leucocyte count was unexpectedly small. No definite change of white blood cell count was found after localized irradiation on the small intestine, while considerable leucopenia resulted in a case of whole-body irradiation. After the exposure to γ rays, water or other nutritional transfusion was given to animals to prevent radiation disease, but it was not effective. (Abstr. Japan Med., 1: No. 9, 1961)

25900 INFLUENCE OF WHOLE-BODY IRRADIATION OF X-RAYS UPON THE MICROSTRUCTURE OF RED CELLS OF MICE. T. Matsuo (Osaka Univ.). Osaka Daigaku Igaku Zasshi, 12: Suppl. 1, 693-8(1960).

At 6 and 24 hours after a single dose (500 r) of whole-body x irradiation, the count of red blood cells and the content of hemoglobin were at about the same level as for normal mice. However, some irregularity was found when the small angle scattering analysis method was applied to the red blood cells. One week after irradiation there was a decrease of the count of red blood cells and hemoglobin with the loss of the inflection point in the curve of the small angle scattering analysis of x rays, an indication that a change of molecular arrangement of hemoglobin might have occurred. It was concluded that the effect of x irradiation on red blood cells is seen in the early stage at the molecular level rather than as morphologic or hematologic changes. (Abstr. Japan Med., 1: No. 9, 1961)

25901 LONG-TERM EFFECTS OF A SINGLE WHOLE-BODY EXPOSURE OF MICE TO IONIZING RADIATIONS. I. LIFE-SHORTENING. Patricia J. Lindop and J. Rotblat (St. Bartholomew's Hospital, London). Proc. Roy. Soc. (London), B154: 332-49(July 25, 1961).

A systematic study was made of the reduction of life span in mice exposed to a single whole-body dose of 15 Mev x rays. 4604 mice of an inbred A substrain were used, all of the same age, 30 days, when irradiated. Nine dose groups, from 50 to 780 r, were used, with a large number of control mice. An analysis of the survival curves revealed two effects of radiation: a reduction in the median age and an increase in standard deviation of the distribution of ages at death. The latter was found to be a quadratic function of dose and it is suggested that the increase is the result of the larger spread in the ages of onset of diseases in irradiated animals. The reduction of life span was found to be proportional to dose, with no threshold. It amounts to 5.66 ± 0.18 weeks per 100 r, or to 38% of the median life span for a dose equal to the LD_{50} (698 r). The difference between the life-shortening in males and females was not statistically significant. The data were also analyzed in terms of Gompertz plots and it was found that they cannot be represented by straight lines, although the displacement of the curves caused by radiation is roughly proportional to dose. The fact that after correcting for the change in standard deviation, all survival curves are parallel to each other, suggests that the effect of exposure is to age the animal, by the removal of a few weeks of its early life. (auth)

25902 LONG-TERM EFFECTS OF A SINGLE WHOLE-BODY EXPOSURE OF MICE TO IONIZING RADIATIONS. II. CAUSES OF DEATH. Patricia J. Lindop and J. Rotblat (St. Bartholomew's Hospital, London). Proc. Roy. Soc. (London), B154: 350-68(July 25, 1961).

The causes of death in mice exposed at the age of 30 days to a single whole-body dose of 15 Mev x rays were analyzed from the point of view of both percentage incidence and distribution in time. Ten groups of death causes were used, based on post-mortem findings. In the lower dose groups (50 to 457 r), the percentage incidence was found, in most cases, to vary very little with dose, but some diseases, such as leukemia, did show a definite increase, and pulmonary tumors, a definite decrease with increasing dose. The changes in incidence were linearly related to the dose. The analysis of survival curves for each cause of death separately revealed that while all causes were advanced by radiation, some were advanced more than others. A definite correlation was found between the acceleration of a given cause of death and the rate of change of the percentage incidence with dose. This suggests that the change of incidence is merely the result of the changed times of onset of disease; an actuarial correction confirmed this. It is concluded that the probability of any one disease occurring remains the same in irradiated as in the control animals, the main effect of the radiation being an advancement, at different rates, of all causes of death. The age of the animal at irradiation may be an important factor in determining the relative acceleration of the different diseases. In the high dose groups (549 to 780 r) a definite decrease in incidence of neoplastic diseases was established. This may be due to a radiotherapeutic effect in cells which later in life became manifest as neoplasms. (auth)

25903 DISAPPEARANCE RATE OF NORMAL BACTERICIDINS IN IRRADIATED MICE. Lottie Kornfeld and C. Phillip Miller (Argonne Cancer Research Hospital, Chicago and Univ. of Chicago). Proc. Soc. Exptl. Biol. Med., 107: 590-4(July 1961).

X-irradiated CF-1 mice lacking normal serum bactericidal activity for Escherichia coli were injected intravenously with highly bactericidal mouse serum. Passively transferred bactericidins were lost so rapidly from the circulating blood as to be undetectable 20 to 30 minutes later. Following 2 intravenous injections 30 minutes apart, bactericidins disappeared almost as quickly as after a single injection. The disappearance rates of normal bactericidins and immune hemagglutinins were compared under identical experimental conditions by injecting a mouse antiserum to sheep cells which was also bactericidal. The half-disappearance time of sheep cell agglutinins in mice was approximately 2 days, that of normal bactericidins, only a few minutes. (auth)

25904 THE EFFECT OF RADIATION ON MAMMALIAN NERVE. Mary C. Arnold, Frank Harrison, and Frederick J. Bonte (Univ. of Texas Southwestern Medical School, Dallas). Radiology, 77: 264-8(Aug. 1961).

Some of the more pertinent work in the area of neuroradiobiology is reviewed. Recent investigations show the smallest single dose of radiation of various common qualities which has been found to produce certain derangements. Data are tabulated. As for structural changes, the subependymal cells of the lateral ventricles have been affected by the lowest

dose. With regard to functional changes, behavioral modifications have occurred at extremely low doses, and other parameters of activity have been affected by moderate doses. The concept of the radiation tolerance of the nervous system has undergone a phasic development. Early histologic studies detected no structural derangements with large doses and, because of limitations in instrumentation, physiologic changes were not found. Hence, nervous tissue was deemed highly radioresistant. The overconfidence fostered by this view has ironically been instrumental in abrogating it. The many reports of clinical derangements following therapeutic doses previously thought safe have contributed in no small way to the reassessment of the radiation tolerance of the nervous system. (auth)

25905 THE LATENT PERIOD, INCIDENCE, AND GROWTH OF Sr^{90}-INDUCED OSTEOSARCOMAS IN CF1 AND CBA MICE. Miriam P. Finkel, Patricia J. Bergstrand, and Birute O. Biskis (Argonne National Lab., Ill.). Radiology, 77: 269-81(Aug. 1961).

CF1 and CBA mice were injected intravenously with a potent carcinogenic amount of Sr^{90} (1.0 μc/gm), after which the appearance and growth of osteosarcomas were studied by serial roentgenography. The osteosarcomas were distributed at random among the mice, the average number being 4.3 among the CF1 and 4.0 among the CBA mice. Tumor incidence recorded at the time of x-ray diagnosis was similar to the incidence recorded at the time of death except that it preceded the latter by about thirty days. However, tumor rate recorded at the time of x-ray diagnosis was very different from the rate recorded at the time of death. The former reached and remained at a plateau; the latter increased until the populations were small. Except for the fact that almost all events occurred about sixty days later among the CBA mice, the tumor data for the two strains were much alike. The tumor data considered along with data on absorbed dose indicate that in this experiment the accumulated dose was relatively unimportant as a carcinogenic stimulus and that the dose rate during the first days after injection provided the amount of radiation necessary to induce malignant bone tumors. It is suggested that 150 rads/day for only one day might approximate the required amount. It is also suggested that dose-response curves reflect the volume of tissue that receives the critical amount of radiation. The average rate of growth of all the tumors for ten weeks, starting with the week of the first positive x-ray diagnosis, followed the power function, $t^{2.87}$. The total mass of neoplastic tissue increased more rapidly in the CF1 than in the CBA population. Consequently, the difference in time of tumor appearance in the two strains, as determined roentgenographically, cannot be attributed to differences in the moment of neoplastic change. It is suggested that the CBA host might provide a less favorable environment for the early establishment and growth of an osteosarcoma than the CF1 host. (auth)

25906 POST-IRRADIATION CHANGES IN PERIPHERAL WHITE BLOOD CELLS OBSERVED WITH FLUORESCENT MICROSCOPY. R. Harding, A. Stein, and J. Mauro (Albany Medical Coll., Union Univ., Albany, N. Y.). Radiology, 77: 282-5(Aug. 1961).

Progressive alterations in the peripheral white blood cell count after therapeutic radiation in man were observed with fluorescent microscopy. In general, there was a reduction in the percentage of mononuclear cells with cytoplasm fluorescing green and an increase in the percentage with cytoplasm fluorescing red. Although the number of patients in the study is small, it appears that alterations in circulating white blood cell counts observed after acridine orange staining is a sensitive index of radiation exposure. Approximately one-half of the patients in this small series showed a marked increase in the percentage of mononuclears with red fluorescent cytoplasm. The full implications of these findings must await further clinicopathologic correlation. (auth)

25907 RBC COUNTS IN X-RAY WORKERS. T. Okamoto, T. Niwa, M. Umehara, and T. Mashita (First Tokyo National Hospital). Tokyo Ikadaigaku Zasshi, 17: 1687(1959).

The RBC counts of 248 x-ray workers were determined 2-4 times each, in March, 1958. Since a rather wide fluctuation was found in the majority, it is recommended that determinations of RBC counts in x-ray workers be made at least twice in each testing period. The count was over 451×10^4 in 61%, 401-450 $\times 10^4$ in 32.6%, and lower than 400×10^4 in 6.4% (average 474×10^4). The difference between maximum and minimum values in repeated tests was less than 50×10^4 in 67.3%, 51-100 $\times 10^4$ in 18%, and over 100×10^4 in 11%. Only in 3.6% did the count not vary. (Abstr. Japan Med., 1: No. 9, 1961)

Radiation Sickness

25908 (AEC-tr-4482(p.590-8)) STUDY ON PROTECTIVE MATERIALS AGAINST RADIATION EFFECTS. PART II. PROTECTIVE MATERIALS AGAINST X-RAY IRRADIATION. U. Sumiki, S. Emoto, M. Namiki, Y. Okazawa, and K. Kuretani.

The results of experiments with mice to study the protective effects of more than 40 compounds against irradiation with x rays are presented. A 100% lethal dose was given by a single total exposure. The chemicals tested injected into the abdominal cavity from 5 to 10 min before the irradiation. No injection was given to the control group. The effectiveness was indicated by the survival rate in the percentage of the group which was subjected to treatment with the chemicals on the date of the total death of the mice in the control group. Amines, sulfur compounds, phenolic compounds, and a few other compounds were tested for their protective effects. Histamine was found to be the most effective. (M.C.G.)

25909 (AEC-tr-4482(p.599-609)) THE EFFECT OF YOGURT ON RADIATION INJURY DUE TO Co^{60}. H. Fujimori, F. Yamada, M. Maeda, S. Takeda, S. Kitaura, and S. Naito.

Mice were irradiated with gamma rays from Co^{60} used as a telecobalt source, and using the rate of decrease in weight and mortality as an index of radiation damages, the variation caused by the administration of yogurt was investigated. It was found that the administration of yogurt is effective in reducing the mortality, prolonging the period before death, and preventing the decrease in weight. (M.C.G.)

25910 (JPRS-7432(p.39-48)) THE PROBLEM OF "RADIATION SHOCK." N. A. Kraevskii (Krayevskiy). Translated from Voenno-Med. Zhur., No. 7, 26-31(July 1960).

Reactions to the effects of excessive stimuli which result in a state of shock are reviewed. It is pointed out that it is possible to distinguish various types of shock depending on the nature of the stimulus. The clinical picture is reviewed briefly for traumatic, anaphylactic, blood-transfusion shock, and burn shock. Results are reviewed from studies which show that under both experimental and clinical conditions a morphologic analysis of shock is entirely possible. The pathological diagnosis of shock is possible and certain aspects of its pathogenesis may be revealed. It is shown that radiant energy can produce a

response reaction of the shock type. An interrelationship has been shown between the severity of radiation injury and the quantity of energy absorbed. It is concluded that radiation shock is more severe in its manifestations than shock states of other origins. Results are summarized from a number of studies on laboratory animals which support this conclusion. (C.H.)

25911 (JPRS-7432(49-54)) CHANGES IN THE FUNCTIONAL CONDITION OF SOME PARTS OF THE BRAIN IN SHOCK IN INTACT AND IRRADIATED ANIMALS. V. I. Popov, A. N. Razumeev (Razumeyev), and G. A. Ryazhkin. Translated from Voenno-Med. Zhur., No. 7, 32-5(July 1960).

Both in intact and irradiated animals the focus of inhibition in shock develops chiefly in the underlying structures rather than in the cortex. The development of shock in irradiated animals occurs with certain characteristics. During the latent period of radiation sickness the animals are more resistant to painful stimulation in combination with blood loss; changes in the nature of responses on electroencephalographic tracings of the cortex and subcortical structures in them are not so pronounced as in the intact animals; on the other hand, during the period of climax shock develops more rapidly, and changes in the nature of the response reactions are manifested to a greater degree than in the intact animals. During the recovery period the state of shock occurs in the same way in the majority of animals as in the healthy animals. (auth)

25912 (JPRS-7432(p.55-60)) PROPHYLAXIS OF RADIATION INJURY BY MEANS OF COMBINATIONS OF THERAPEUTIC AGENTS. L. A. Tiunov. Translated from Voenno-Med. Zhur., No. 7, 36-9(July 1960).

A survey was made of literature on the prophylaxis of radiation injuries. It is concluded that effective antiradiation drugs may be prepared by a combination of typical sulfhydryl protective preparations. (C.H.)

25913 (JPRS-7432(p.61-8)) CHARACTERISTICS OF THE COURSE OF SOME VIRUS INFECTIONS AGAINST THE BACKGROUND OF RADIATION INJURY. P. I. Remezov. Translated from Voenno-Med. Zhur., No. 7, 40-4(July 1960).

Ionizing radiation, acting on the body, to a considerable degree changes the clinical and biological picture of virus infections. Even comparatively small doses of ionizing radiation reduce the resistance of mice to many viruses. The characteristics of the course of virus infections in the irradiated organism depend not only on the doses of irradiation but also on the time which has elapsed from irradiation to infection. The greatest reduction in the resistance of the body to viruses is noted during the period of maximum development of the body's reaction to irradiation. The resistance of the organism is returned to normal approximately three to 3.5 months after irradiation. Chronic irradiation even with small doses, such as 10 r, also reduces the resistance of the body to viruses. The degree of reduction of resistance in this case is directly proportional to the total dose of irradiation. After prolonged irradiation of mice twice a week in a dose of 0.33 r no abnormalities were noted in the clinical or virological characteristics of virus infections. However, after infection with various viruses more animals always die among the group irradiated than among the non-irradiated group. (auth)

25914 (JPRS-7432(p.69-78)) CHARACTERISTICS OF THE COURSE OF SOME DISEASES OF THE INTERNAL ORGANS AGAINST THE BACKGROUND OF RADIATION INJURY. G. A. Krivkov, Ya. I. Veksler, and A. R. Sheingerts (Sheyngerts). Translated from Voenno-Med. Zhur., No. 7, 45-50(July 1960).

Results are presented from a study of the effects of radiation injury on the clinical course of exudative pleurisy and myocarditis in rabbits. The data indicate that the course of the pathological processes is changed in the irradiated animal. It is pointed out that in the case of combined disease and radiation sickness there may be difficulty in diagnosis and selection of therapeutic methods. (C.H.)

25915 (JPRS-7432(p.79-85)) CHANGES IN THE KIDNEY FUNCTION IN ACUTE RADIATION SICKNESS. V. F. Kovalev. Translated from Voenno-Med. Zhur., No. 7, 51-4(July 1960).

Acute radiation sickness is associated with distinct changes in the kidney function, whereby the degree is determined by the severity of the sickness. Pronounced changes in the kidney function occur during the phase of the primary reaction and during the climax of the sickness. The most marked disturbances in the function of urine excretion occur in the terminal period. In the latent period and during the period of recovery the changes in kidney function are less pronounced or altogether absent. The most pronounced changes are undergone by glomerular filtration, up to the point of complete cessation of urine production in the terminal period of the severe form of radiation sickness. The changes in tubular resorption are less pronounced. In radiation sickness disturbances occur in the secretory power of the renal tubules with respect to the excretion of the dye phenol red, and a reduction occurs in the chloride excretion in the urine without any notable increase in their level in the blood, which is apparently associated with a retention of chlorides in the tissues. Disturbances in urine production after local irradiation of the kidney area occur only when the dose of x rays considerably exceeds the therapeutic dose. The change in kidney functions after external whole-body irradiation is produced chiefly by the complex neurotrophic disturbances in the irradiated organism and, to a lesser degree, by the direct injurious effect of x rays on the renal tissue. (auth)

25916 (JPRS-7432(p.86-93)) X-RAY DIAGNOSIS OF GAS GANGRENE INFECTION IN RADIATION COMBINED INJURIES. L. S. Korchanov and P. P. Kondrat'ev (Kondrat'yev). Translated from Voenno-Med. Zhur., No. 7, 55-9(July 1960).

In the case of the vigorously progressive form of gas gangrene infection radiographic examination is the earliest method of diagnosis. Gas in the soft tissues of the injured extremity is found one to three hours after infection, that is, at the time when there are no clinical signs of gas gangrene infection. The gas formation process develops the same way in non-irradiated animals as in animals which have been exposed to penetrating radiation before infection. In animals infected with the pathogens of anaerobic infection during the period of the climax of acute radiation sickness, the x-ray method of investigation is the principal diagnostic method. Through comparison of the clinical picture of gas gangrene infection and the data of x-ray investigation a certain parallelism is found between the degree of manifestation of the clinical sign and the x-ray picture. The more severely the gas gangrene infection occurs the more varied and more extensive the foci of pathological rarefaction on the x-ray films. (auth)

25917 (JPRS-7432(p.94-100)) TISSUE ACCEPTANCE OF FOREIGN BODIES IN RADIATION SICKNESS. V. I. Gal'chikov, I. S. Slizkii (Slizkiy), A. V. Tuzikov, and O. V.

Shnyrenkova. Translated from Voenno-Med. Zhur., No. 7, 60-4(July 1960).

Foreign bodies and the injuries produced by them in tissues and organs of irradiated animals do not exert any notable influence on the course of radiation sickness with the exception of cases in which the tissue is considerably destroyed at the time of infliction of the trauma as well as where there is a purulent-necrotic complication of the wound process. Radiation sickness of mild and moderate degrees of severity, developing as the result of irradiation with x-rays, does not delay the process of encapsulation of foreign bodies in the tissues and organs of experimental animals. In the case of a severe degree of radiation sickness the encapsulation of the foreign body is markedly retarded. Radiation sickness caused by radioactive substances injected directly into the tissues delays the plastic process. The use of penicillin contributes to a reduction in the number of post-traumatic complications. In addition to penicillin the use of streptomycin and other antibiotics, which can exert a beneficial effect in mixed infection, is possible. Surgical tactics for foreign bodies deeply situated in tissues and organs and not removed in the primary debridement from those affected by ionizing radiation should be performed in accordance with the clinical signs of the wound and with consideration of the possible functional-morphologic disturbances and late complications. (auth)

25918 (JPRS-7432(p.106-9)) NUTRITION IN ACUTE RADIATION INJURIES. I. V. Fedorov and G. V. Sazykin. Translated from Voenno-Med. Zhur., No. 7, 69-71(July 1960).

A general diet is recommended for patients with acute radiation sickness. Some dietary precautions are necessary, especially in the case of persistent colitis or enterocolitis, hemorrhage, or anorexia. These precautions are discussed. (C.H.)

25919 HEMATOLOGICAL CHANGES DURING RADIATION SICKNESS. J. Pospíšil, Z. Dienstbier, and M. Arient (Charles Univ., Prague). Atompraxis, 7: 255-8(July 1961). (In German)

Dogs which received a whole-body dose of 400 r showed a reduced ameboid activity of the leukocytes, which reached a maximum between the 8th and the 22nd day. This confirms the observation that the body's resistance to infections is lowered, following massive irradiation, from the 2nd week onward. No reduction of ameboid activity in the leukocytes was observed in dogs which had received a whole-body dose of 25 r. (auth)

25920 THE INTERVAL BETWEEN IRRADIATION AND BONE-MARROW TRANSPLANTATION. O. Vos, B. G. Crouch, and D. W. van Bekkum (National Defence Research Organization, T.N.O., Rijswijk, Netherlands). Intern. J. Radiation Biol., 3: 337-49(July 1961).

An improved 30-day survival was found in CBA mice treated with rat bone marrow if the cells were injected about 24 hours instead of a few hours after a lethal dose of total-body irradiation. No change of mortality was found in C57BL and F_1 hybrid mice treated in the same way with rat bone marrow; both the immediate and delayed treatment resulted in a high percentage survival. A further delay of injection beyond 24 hours caused a progressive decrease of 30-day survival. Mice irradiated with a median lethal dose of x rays showed a better 30-day survival if homologous or heterologous bone-marrow treatement was delayed for 24 hours after irradiation. The effect was most evident in C57BL mice. Occurrence of donor cells in the blood of the chimeras was studied. A 24-hour interval between irradiation and treatment had no significant effect on the number of cells needed for protection. (auth)

25921 THE EFFECT OF ETHYLENEDIAMINETETRAACETATE ON THE SURVIVAL OF X-IRRADIATED RATS. R. H. Rixon and J. F. Whitfield (Atomic Energy of Canada Ltd., Chalk River, Ont.). Intern. J. Radiation Biol., 3: 439-42(July 1961).

Injection of Na_2-EDTA immediately before or after irradiation (740 r) significantly increased the 30 day survival. The injection of Ca-EDTA immediately before irradiation only increased the survival slightly. Observations show that the protective action of appropriate doses of Na_2-EDTA is related to the chelation of serum calcium and probably to the mobilization of bone calcium. (P.C.H.)

25922 TREATMENT OF TOTAL-BODY X-IRRADIATED MONKEYS WITH AUTOLOGOUS AND HOMOLOGOUS BONE MARROW. B. G. Crouch, L. M. van Putten, D. W. van Bekkum, and M. J. de Vries (National Defense Organization TNO, Rijswijk Z. H., Netherlands and Radiobiological Inst. TNO, Rijswijk Z. H., Netherlands). J. Natl. Cancer Inst., 27: 53-65(July 1961).

Rhesus monkeys were given injections of autologous or homologous bone marrow after total-body x irradiation. After doses of 650 r or more, untreated monkeys survived for 12 to 16 days without recovery of the peripheral blood counts. Five of 6 animals treated with 2.2 to 12.9×10^8 autologous bone marrow cells after radiation doses of 850 to 950 r showed hematopoietic recovery and survived for over 100 days. After lethal radiation doses and treatment with more than 8×10^8 homologous bone marrow cells, recovery of hematopoiesis was observed in 14 monkeys. In most of these male animals the proliferation of female donor cells was demonstrated by the presence of typical "drumsticks" in the polymorphonuclear granulocytes of the peripheral blood. However, only 2 animals survived more than 30 days, and the average survival time, 21.6 days, was only slightly longer than that of the controls. A syndrome of anorexia, diarrhea, and wasting, often combined with dermatitis or jaundice, occurred only in the animals treated with foreign bone marrow. From the similarity of this syndrome and the autopsy findings to those of secondary disease in rodents, it is concluded that the monkeys which, after irradiation, were treated with homologous bone marrow died from severe and early development of secondary disease. The implications of these findings are discussed. (auth)

25923 PATHOLOGIC CHANGES IN IRRADIATED MONKEYS TREATED WITH BONE MARROW. M. J. de Vries, B. G. Crouch, L. M. van Putten, and D. W. van Bekkum (Radiobiological Institute TNO, Rijswijk Z. H., Netherlands and National Defense Organization TNO, Rijswijk Z. H., Netherlands). J. Natl. Cancer Inst., 27: 67-97(July 1961).

Autopsy was performed on 27 irradiated monkeys. The 7 irradiated nontreated animals died on the bone marrow syndrome. Intestinal radiation death occurred in one treated with autologous bone marrow; bone marrow regeneration was delayed in the other animal that died with anemia and hemorrhagic pulmonary edema. In 3 animals treated with homologous bone marrow, there was no apparent regeneration but it occurred in the 14 others treated with homologous bone marrow cells. The pathologic changes closely resembled those found in mouse, rabbit, and human radiation chimeras suffering from secondary disease, which in the primate radiation chimera seems more severe than usually occurs in irradiated mice treated with foreign bone marrow. Since many lesions found in monkeys are more pronounced than those in rodents, this study has been illuminating in the pathogenesis of secondary disease. Cell loss, possibly a direct effect of an immunological reaction of the foreign

bone marrow graft against the tissues of the host, was the primary lesion, amounting to severe necrosis and atrophy in many organs. In lesions of the intestinal tract, degenerative changes prevailed over regenerative while the reverse was true for early skin lesions. Although infectious disease occurred less frequently than in mouse chimeras impairment of the immunological defense system may have promoted invasion by commensal parasites or activation of latent infections. Mortality in animals treated with foreign bone marrow probably was caused by widespread denudation of ileum and colon and sometimes by massive liver necrosis or infectious disease. (auth)

25924 EXPERIMENTAL STUDIES ON THE NATURE OF X-RAY INJURIES. I. INFLUENCES OF CYTOTOXIN, PRODUCED BY LARGE-DOSE RADIATION, ON VARIOUS TISSUES (BLOOD CELLS AND TESTES IN PARTICULAR). S. Kojima (Okayama Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2331-42(1960).

The nature of cytotoxin produced by x irradiation and particularly its influence on various tissues, such as blood cells and testes, was studied. The unsaturated fatty acid fraction, extracted from the liver of a rabbit, irradiated with 3000 r was injected intravenously into another group of normal rabbits. The leucocyte count of the serabbits decreased to about the same amount as in the rabbits exposed directly to x rays. Toxic granules in the leucocytes were observed in both cases. The histological changes in the testes were the same as in those irradiated directly on the testes, such as the disappearance of spermatozoa, an inhibitory picture of the mitosis of the spermatogonia, and appearance of polykaryocytes. From these findings it may be concluded that when x rays were given, biochemical changes occurred in living tissue cells to produce an unsaturated fatty acid fraction which injured the normal cells. (Abstr. Japan Med., 1: No. 9, 1961)

CHEMISTRY

General and Miscellaneous

25925 (AD-254730) STUDY OF THE REACTION RATES BETWEEN REFRACTORY OXIDES AND GRAPHITE. Semi-Annual Progress No. 7, September 16, 1960 to March 15, 1961. K. L. Komarek and N. Klinger (New York Univ., New York. Coll. of Engineering). Mar. 1961. Contract AF 33(616)-6082. 10p.

Efforts during the period were devoted mostly to observations on aluminum and magnesium oxides. A value of 310,000 calories was substantiated as the activation energy for the Al_2O_3–graphite reaction. The activation energy for MgO–graphite was found to be 59,500 calories. Preliminary calculations for spinel ($MgO-Al_2O_3$) indicate that the activation energy is higher than for magnesia and may be between alumina and magnesia. (J.R.D.)

25926 (HW-63855) GAS-GRAPHITE REACTIONS. I. THERMAL AND MICROWAVE OXIDATION OF VARIOUS REACTOR-GRADE GRAPHITES. T. J. Clark (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 10, 1960. 19p.

Thermal oxidation of graphite in flowing CO_2 is being studied at 650 to 850°C, in a single-pass gas system at atmospheric pressure, by observing weight loss rates. The method is used to provide comparative data for candidate reactor graphites. The effects on oxidation rates of graphite purity, structure, coke type, graphitization temperatures, and other manufacturing variables are determined. In addition, the effects of gas flow rates and graphite surface to volume ratios are observed. A low-pressure microwave glow discharge at 2450 megacycles is established in air, carbon dioxide, and carbon monoxide. Oxygen atoms are produced in these gases and accelerated reaction rates are observed. Under certain conditions carbon suboxide is formed, leading to mass transport and deposition of amorphous carbon on hot quartz surfaces of the equipment. Electron micrographs of this carbon reveal bundles of filaments, each of which is composed of ultimate platelets much smaller than ordinary amorphous carbon or soot. (auth)

25927 (NP-10415) RESEARCH ON INORGANIC POLYMERS. Quarterly Progress Report No. 1, January 1 to April 15, 1961. Ross I. Wagner, Robert M. Washburn, and Robert D. Stewart (American Potash and Chemical Corp., Whittier, Calif.). With this is bound: APPENDIX I. CHEMISTRY OF INORGANIC POLYMER COMPONENTS V. An Interim Report of Progress, April through June 1961. Anton B. Burg, Hans W. Birnkraut, John F. Nixon, and Louis K. Peterson (University of Southern California, Los Angeles). July 15, 1961. Contract AF33(616)-7810. 92p.

The program to evaluate selected borophane polymers as laminating resins for glass cloth was initiated using methylsesquimethyleneborophane as the first candidate resin. Conditions for formation of laminates were delineated but the properties of the resulting laminates were not evaluated. A series of linear methyl-n-alkylborophane polymers (n-propyl through n-octyl) and linear methylphenylborophane polymer were prepared and separated from the by-product cyclic triborophanes. Thermal depolymerization of an equimolar mixture of linear dimethyl- and methylethylborophane polymers has produced approximately equimolar amounts of the four cyclic triborophanes suggesting a monomeric intermediate. A variety of B-substituted triborophane derivatives including formoxy, acetoxy, benzoxy, thiocyano and isocyanato functional groups were prepared. Several new phosphonyl azides, thiophosphonyl azides and phosphoranes were prepared to screen these new bond systems as prototypes for polymers. Effort was directed toward the purification of the borimidazole type polymer and toward the preparation of a borimidazole type polymer incorporating an aromatic ether linkage. Both the Neumayer and microebulliometric molecular weight apparatus were calibrated for use with solvents other than benzene thus extending the usefulness of the equipment. (auth)

25928 (ORNL-3057) THE DEAMINATION AND REARRANGEMENT OF ERYTHRO-1-AMINO-1-PHENYL-2-o-TOLYL-2-PROPANOL (thesis). M. M. Staum (Oak Ridge National Lab., Tenn.). Aug. 16, 1961. Contract W-7405-eng-26. 93p.

Submitted to the Univ. of Florida.

An investigation was carried out on the nitrous acid deamination of one enantiomer of erytho-1-amino-1-phenyl-2-o-tolyl-2-propanol. The results are compared with those for the corresponding threo aminoalcohol, and a reaction mechanism is postulated on the basis of an open carbonium ion, with a minimum of rotation about the C–C bond. (D.L.C.)

25929 (TID-11047) CHEMICAL PROCESS REPORT [ON] CONTINUOUS SULFATION. Progress Report, July 1, 1960–September 30, 1960. Carl S. Pomelee and Jack P. Spenard (Brush Beryllium Co., Cleveland). Contract AT (11-1)-462. 13p.

A larger pilot-scale unit was designed for the continuous sulfuric-acid extraction of ground, heat-treated beryl. The unit is being constructed. (auth)

25930 (AEC-tr-4451) JOURNAL OF INORGANIC CHEMISTRY. Translation of Zhur. Neorg. Khim.; 3: No. 3, 1958. 435p.

Twenty-seven papers and six discussions are included which were presented at the Conference on Phase Diagrams of Metallic Systems held on May 17 to 20, 1957. Separate abstracts have been prepared for four of the papers; three of the remaining 23 papers were previously abstracted in the NSA. (D.L.C.)

25931 (AEC-tr-4482(p.423-38)) COPRECIPITATION OF SILVER ON TELLURIUM. K. Kudo.

The coprecipitation of silver on tellurium was investigated. The collecting condition of silver contained in a hydroponic (peppermint) plant, cultivated in a solution containing Ag^{110}, and the artificial ash solution with tellurium was studied, and the amount of silver in the peppermint plant was determined colorimetrically. The collection of silver in combination with the dithizone method is described. The results indicated that more than 1 μg of silver is necessary for getting the collection ratio above 80%. Therefore more than 1 g of ash is essential for the quantitative determination of silver. (M.C.G.)

25932 (AEC-tr-4482(p.439-46)) FRACTIONATION OF SULFUR DURING OXIDATION. I. Iwasaki and H. Fukutomi.

The abundance ratio of various isotopes of sulfur in the process of oxidation and reduction reaction was investigated. S^{35}-labeled sulfide was prepared. The sulfide was oxidized to sulfate and precipitated as barium sulfate in about 10 fractions. The radioactivity of these barium sulfate samples was measured. Barium sulfate obtained in the

earlier stage of oxidation showed higher radioactivity than that obtained in the later stage of oxidation. There was no big effect of temperature on the variation. (M.C.G.)

25933 (AEC-tr-4482(p.447-50)) USE OF S^{35} IN STUDIES ON THE VARIATION IN CRYSTAL FORMS OF CANE SUGAR AND THE CAUSE OF THE FORMATION OF BEAUTIFUL CRYSTALLINE FORMS IN THE PRESENCE OF Mn. K. Suzuki.

Crystals of beet sugar obtained from a solution containing a low concentration of Mn^{2+} were relatively colorless. The cause for this was studied with radioautographic methods. S^{35} in Na_2SO_4 was used with $MnSO_4$. The radioautographic studies of the sugar crystal obtained showed the adsorption of $MnSO_4$ on the facets of (110) and (101). It appeared that the adsorption of $MnSO_4$ on certain facets depressed the development of the facets, causing steady and compact development of the sugar crystals. The amount of the reducing sugar became less and the development of the crystal was homogeneous in the direction of the three axes, giving cubic form, instead of a longer form. In this way, crystals without turbidity and cracks were obtained. It seemed, however, that only with this effect of Mn^{2+} did the rate of crystal development become slower. The presence of Mn^{2+} decreased the viscosity of the sugar solution, the rate of deposition of sugar became larger, and the formation of the pseudocrystals were depressed. (auth)

25934 (AEC-tr-4769) THE EFFECT OF ADDITIONS OF SOME SUBSTANCES ON THE INTENSITY OF SPECTRAL LINES OF NIOBIUM AND TANTALUM. N. I. Tarasevich and A. D. Khlystova. Translated from Vestnik Moskov. Univ., Ser. II., 13: No. 1, 215-22(1958). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 9781.

25935 (AERE-Trans-868) STOICHIOMETRIC ANALYSIS OF CHEMICAL REACTIONS IN THE BURNING AND GASIFICATION OF CARBON. B. M. Derman. Translated by V. Beak for U.K.A.E.A. Atomic Energy Research Establishment from Trudy Inst. Goryuchikh Iskopaemykh, Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, 11: 127-32(1959). 11p.

A treatment of stoichiometric relationships in chemical reactions is presented for parallel and successive reactions such as these in the burning of carbon. (D.L.C.)

25936 THE CHEMISTRY OF THE METAL OXALATO COMPLEXES. Kotra V. Krishnamurty and Gordon M. Harris (Univ. of Buffalo). Chem. Revs., 61: 213-46(June 1961).

A review is given of the occurrence, preparation, and properties of oxalic acid and the simple oxalates; the general classification, structure, stability, and reactions and reaction kinetics of the complex oxalates; and the analytical and industrial applications of the oxalates. A literature survey is also given which includes 456 references to U. S. and foreign books and journals published through 1959. (P.C.H.)

25937 DISSOCIATION ENERGIES OF GASEOUS METAL DIOXIDES. Leo Brewer and Gerd M. Rosenblatt (Univ. of California, Berkeley). Chem. Revs., 61: 257-63(June 1961).

Free energy functions of gaseous metal dioxides estimated by a consistent procedure that allows enthalpy data for various molecules to be compared with one another are presented. The rotational contribution is calculated assuming linear molecules and the internuclear distances observed for the gaseous monoxides, and the vibrational frequencies used to calculate the vibrational contribution to the free energy function were also obtained from the values observed for the monoxides where they are known. The free energy functions were then used to evaluate all available data for gaseous MO_2 oxides and to obtain enthalpies of dissociation into gaseous atoms at 298.15°K for the molecules. The original data treated, the reaction assumed to be occurring, and the sources of the auxiliary thermodynamic quantities used for each molecule listed are given. (P.C.H.)

25938 THE MAGNITUDE OF THE PRIMARY KINETIC ISOTOPE EFFECT FOR COMPOUNDS OF HYDROGEN AND DEUTERIUM. F. H. Westheimer (Harvard Univ., Cambridge, Mass.). Chem. Revs., 61: 265-73(June 1961).

A review is given of small deuterium isotope effects, the first approximation for the calculation of the ratio k_H/k_D, experimental data, some general and special cases, and the qualitative and quantitative aspects of the theory. The theory is discussed in terms of carbon-hydrogen and carbon-deuterium bonds, but will also apply to bonds with other elements and, by a simple extension, to compounds of tritium. (P.C.H.)

25939 RARE EARTH METALS. OCCURRENCE, EXTRACTION AND IMPORTANCE. Franz Matthes. Chem. Tech. (Leipzig), 13: 290-2(May 1961). (In German)

A survey is given of the occurrence, obtention, and utilization of the rare earth metals. 29 references. (J.S.R.)

25940 THE COMPOSITION AND PROPERTIES OF THE URANATES. E. A. Ippolitova and L. M. Kovba (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 138: 605-7 (May 21, 1961). (In Russian)

The reactions of U_3O_8 with the alkali metals and alkaline earths are reviewed. Diuranates are first formed during the interaction of uranium oxides with the nitrates, chlorides and sulfates of sodium and potassium (as well as with the carbonates). In contrast to the alkali metals, calcium uranate, cadmium uranate (α-form) and $SrUO_4$ (β-form) are formed by the interaction of U_3O_8 with the corresponding chloride. The oxides and carbonates react with the monouranates, and give the orthouranates Me_3UO_6(Ca, Sr, Ba and Cd), and Me_2UO_5(Ca, Sr, Ba, and Pb). The monouranates of Sr and Pb can dissolve UO_3 (at temperatures of 1100 and 600°C, respectively). The uranates of the alkali elements depending on the composition undergo thermal decomposition either with the loss of the alkali oxide and by separation of U_3O_8. In the case of the divalent elements, decomposition of the uranate is ordinarily accompanied by the formation of a solid solution $(Me,U)O_{2+x}$ with a fluorite structure. The composition of the hydrogen-reduction products of the uranates depends on the stability of the lower valence state of uranium (V or IV) in the particular system. Thus, the monouranates of lithium and cesium are reduced to UO_{2+x} by hydrogen at a low temperature (350 to 400°C). On reducing a more acid uranate (for example, $K_2U_3O_{10}$), a uranate (V) and UO_{2+x} is obtained. In titrating a uranyl salt with alkali, inflection points are observed on the titration curve which correspond to the formation of $UO_2(OH)NO_3$ (pH of 2.5 to 3.5), $(UO_2)_2(OH)_3NO_3$ (pH of 3.5 to 5.0), $UO_2(OH)_2$ (pH of 4.0 to 5.5), $Me_2U_7O_{22}$ (pH of 6.0 to 6.5), $Me_2U_4O_{13}$ (pH of 7.0 to 9.0) and $Me_2U_3O_7$ (pH of 9.0 to 11.0). As a result of chemical and x-ray analyses of sodium uranate precipitates at various pH the existence of two phases was established: $Na_2O\cdot$ 2 to 4 UO_3 with a $CaUO_4$ structure and $Na_2O\cdot$ 4 to 7 UO_3 with a structure of potassium tri-hexauranate. (TTT)

25941 SECONDARY HYDROGEN ISOTOPE EFFECT IN THE NITRATION OF TOLUENE. H. Suhr and Hch. Zollinger (Eidgenössische Technische Hochschule, Zurich) Helv. Chim. Acta, 44: 1011-16(1961). (In German)

The isomer ratio in the mono-nitration of toluene and α-d_3-toluene was measured by gas chromatographic separation. The percentage of o- and p-nitrotoluene is not influenced significantly by the isotopic substitution in the methyl group; there is, however, a difference in the formation of the m-isomer, demonstrating an inverse secondary isotope effect ($k_H/k_D = 0.94$) for the substitution in the m-position. The overall nitration ratio is not significantly changed by the isotopic substitution, as the m-compound is a minor product only. Preliminary nitration experiments with toluene containing a deuterium atom in o-, m- or p-position do not show changes in the isomer ratio. (auth)

25942 THE BASE CATALYZED EXCHANGE OF PHENYLACETYLENE-t_1 IN AQUEOUS SOLUTION. E. A. Halevi and F. A. Long (Cornell Univ., Ithaca, N. Y.). J. Am. Chem. Soc., 83: 2809-14(July 5, 1961).

The rate of exchange of the active hydrogen of phenylacetylene was studied in aqueous solutions at 25° using tritium labeling. The reaction with hydroxide ion is first order in base, the rate coefficient being 2.7×10^2 l mole^{-1} sec^{-1}. Comparison studies for the solvents deuterium oxide and water lead to a ratio of second order rate coefficients of $k_{OD^-}/k_{OH^-} = 1.34$, about as expected for the postulated one-step slow proton transfer mechanism. Experiments with aqueous buffers of tris-(hydroxymethyl)-amine, of 2,6-lutidine and of ammonia give evidence that the reaction is catalyzed by general bases but, relative to hydroxide ion, the contribution of the weaker bases to the rate is not so large as to make the evidence conclusive. The uncatalyzed exchange was searched for but not detected indicating that the proton transfer to water as a base cannot have a rate coefficient larger than about 2×10^{-10} l mole^{-1} sec^{-1}. The kinetics for base catalysis, when combined with information on the acid dissociation constant of phenylacetylene, indicate that the rate coefficient for proton transfer from the acid water to the phenylacetylene anion is of the order of 10^8 l mole^{-1} sec^{-1} and that the value for the similar reaction with hydronium ion is probably around 10^{11}. The exchange was also measured with the tritium label in the water and the same exchange rate coefficient was observed as in the forward direction, the value being associated in both cases with the rate of rupture of the carbon–tritium bond. (auth)

25943 THE CRYSTAL STRUCTURE OF ETHYLENEDIAMINE TRIBROMOPLATINUM ($C_2N_2H_8$) $PtBr_3$. Thomas D. Ryan and R. E. Rundle (Ames Lab., Ames, Iowa). J. Am. Chem. Soc., 83: 2814-16(July 5, 1961).

$Pt(en)Br_3$ is a complex between $Pt(en)Br_2$ and $Pt(en)Br_4$. The orthorhombic crystals, a = 5.60, b = 14.77, c = 10.12 Å contain $Pt(IV)enBr_2$ and $Pt(II)enBr_2$ planar (or nearly planar) groups lying parallel to (100) and connected with essentially linear, ordered, Pt(II) · · · Br–Pt(IV)–Br · · · Pt(II) · · · chains running along a. Between chains Pt(II) and Pt(IV) positions can be exchanged at random. The distance Pt(IV)–Br along the chains is 2.48 Å, and the average Pt(II)–Br, Pt(IV)–Br distance within the planar groups is 2.51 Å, not significantly different. Light with its electric vector along the chains is very strongly absorbed. Presumably this is a charge transfer absorption. (auth)

25944 MAGNETIC COMPOUNDS OF HEXAVALENT RHENIUM WITH THE PEROVSKITE-TYPE STRUCTURE. John Longo and Roland Ward (Univ. of Connecticut, Storrs). J. Am. Chem. Soc., 83: 2816-18(July 5, 1961).

Phases of composition $A^{II}(B_{.5}^{II}Re_{.5}^{VI})O_3$ were prepared by interaction of metal oxides under controlled conditions. When A^{II} is barium and B^{II} represents the divalent cations Ca, Mg, Mn, Fe, Co, Zn, and Cd, the compounds are all of the cubic ordered perovskite type. The compounds with manganese and iron are magnetic. Substitution of strontium and calcium in the A position when B^{II} is iron leads to distorted structures apparently related to the cubic perosvkite type. The approximate Curie temperatures for the magnetic phases were determined. (auth)

25945 THE MECHANISM OF THE EXCHANGE OF CHROMIUM(III) AND CHROMIUM(VI) IN ACIDIC SOLUTION. Carl Altman and Edward L. King (Univ. of Wisconsin, Madison). J. Am. Chem. Soc., 83: 2825-30(July 5, 1961).

The rate of exchange of chromium(III) and chromium(VI) in acidic aqueous solution at 94.8° is governed by the rate law: Rate = $[Cr(OH_2)_6^{+3}]^{1/2}$ $[H_2CrO_4]^{1/2}$ $\{k[H^+]^{-2} + k'\}$. On the basis of the rate law it is concluded that the rate-determining step in the exchange is a reaction of chromium(III) and chromium(V), chromium(V) being in chemical equilibrium with chromium(III) and chromium(VI). The chromium(III)–chromium(VI) exchange is completed by the relatively rapid exchange of chromium(V) and chromium(VI). The values of k and k' for solutions of ionic strength = 0.92 M are 6.6×10^{-7} moles l^{-1} sec^{-1} and 1.4×10^{-5} mole^{-1} l sec^{-1}, respectively. In arriving at the conclusions, the probable presence of appreciable amounts of dimeric chromium(VI) in the reaction solutions was neglected and a relatively uncertain value of the first dissociation constant of monomeric chromic acid was used. (auth)

25946 ALKALINE EARTH–TANTALUM–OXYGEN PHASES INCLUDING THE CRYSTAL STRUCTURE OF AN ORDERED PEROVSKITE COMPOUND, $Ba_3SrTa_2O_9$. Francis Galasso, James R. Barrante, and Lewis Katz (Univ. of Connecticut, Storrs). J. Am. Chem. Soc., 83: 2830-2 (July 5, 1961).

Further investigation of the perovskite-like phases $Ba_3CaTa_2O_9$ and $Ba_3SrTa_2O_9$ indicates that an x-ray powder pattern of the first can be indexed on a 4.17 Å cubic cell, while for the second a hexagonal cell with a = 5.95, c = 7.47 Å is required. The structure of the latter is described as a repetition of three close packed BaO_3 layers with Sr and Ta in an ordered arrangement in octahedral holes. When the phase is heated in the presence of silica it changes to a $Ba_5Ta_4O_{15}$ type compound. From a plot of cell sizes for solid solutions of $Ba_5Ta_4O_{15}$ and $Sr_5Ta_4O_{15}$, it was found that the cell size of the product on heating corresponded to the composition $(Ba_{.8}Sr_{.15})_5Ta_4O_{15}$. (auth)

25947 THE HYDROLYSIS OF OCTAHEDRAL COMPLEXES OF ARSENIC(V): THE KINETICS OF HYDROLYSIS OF THE CATECHOL COMPLEX. John H. Craddock and Mark M. Jones (Vanderbilt Univ., Nashville). J. Am. Chem. Soc., 83: 2839-43(July 5, 1961).

A study of the kinetics of hydrolysis of the arsenic(V)–catechol complex was carried out to provide information on the behavior of a typical inert outer-orbital complex of a non-transition element. Examination of the levo complex indicates that it does not racemize or hydrolyze in strongly basic solutions even at elevated temperatures. As the pH drops, the rate of hydrolysis becomes measurable in the region of pH values from 3, where it is slow, to about 1.2, where it is rather fast. In this region, the rate of hydrolysis is given by the second-order expression $-d[l(-)\text{-complex}]/dt = k_2[H^+]\,[l(-)\text{-complex}]$. The temperature dependence of the rate in various buffered solutions over the range 25–35° leads to the following values for the free energy, enthalpy, and entropy of activation: $\Delta F^\ddagger = 20$ kcal, $\Delta H^\ddagger = 24$ kcal, and $\Delta S^\ddagger = 15$ eu. The rate of hydrolysis is unaffected by added arsenite or arsenate. The addition of catechol is found to increase the rate of hydrolysis slightly.

The over-all results indicate that the gross mechanism of the hydrolytic process may not be radically different from that found for some complexes of transition element ions. (auth)

25948 SLOW PROTON TRANSFER REACTIONS. III. THE MECHANISM OF ACID-CATALYZED AROMATIC HYDROGEN EXCHANGE IN 1,3,5-TRIMETHOXYBENZENE. A. J. Kresge and Y. Chiang (Brookhaven National Lab., Upton, N. Y.). J. Am. Chem. Soc., 83: 2877-85(July 5, 1961).

General acid catalysis was detected in the exchange of aromatic hydrogen of trimethoxybenzene: rates of loss of tritium from 1,3,5-trimethoxybenzene-2-t to seven acids ranging in strength from H_3O^+ to H_2O conform to the Brönsted relation $k_A = 4.72 \times 10^{-2} (K_A)^{0.318}$. This fact is inconsistent with a previously assigned mechanism for aromatic hydrogen exchange; that is, the scheme consisting of reversible formation of a loose complex between proton and aromatic substrate followed by slow intramolecular isomerization of this complex. Instead, general acid catalysis indicates a simple slow proton transfer mechanism for exchange. The loss of tritium from 1,3,5-trimethoxybenzene-2-t is not catalyzed by bases. This shows that the proton transfer is not a concerted process, but that reaction takes place in two discrete steps: proton addition to give a phenonium ion followed by proton abstraction to give exchanged trimethoxybenzene. This mechanism, unlike the one first proposed for aromatic hydrogen exchange, is wholly consistent with generally accepted mechanistic schemes for other electrophilic aromatic substitutions. (auth)

25949 TECHNETIUM CARBONYL. J. C. Hileman, D. K. Huggins, and H. D. Kaesz (Univ. of California, Los Angeles). J. Am. Chem. Soc., 83: 2953-4(July 5, 1961).

The synthesis and properties of a new carbonyl and its derivatives with iodine are reported. The molecular weight required for $Tc_2(CO)_{10}$ is 478, and 465 ± 26 was found. The accuracy of the method depends on the tensimetric homogeneity of the solvent. Technetium carbonyl reacts slowly with iodine at 100°C requiring close to 30 hr to reach completion. (P.C.H.)

25950 TETRAFLUOROHALATES OF CESIUM, RUBIDIUM AND POTASSIUM. L. B. Asprey (Los Alamos Scientific Lab., N. Mex.), John L. Margrave, and Merlin E. Silverthorn. J. Am. Chem. Soc., 83: 2955-6(July 5, 1961).

Fluorination of alkali chlorides produces alkali tetrafluorochlorates, $MClF_4$, and is explained by the reaction $MCl + 2\ F_2 = MClF_4$. Cesium and potassium tetrafluorochlorates were prepared at 90–250°. The order of stability is Cs > Rb > K, and the order of reactivity with water is Cl > Br > I. (P.C.H.)

25951 MOLECULAR GEOMETRY AND THE VAPOR PRESSURE OF ISOTOPIC MOLECULES. THE EQUIVALENT ISOMERS cis-, gem- AND trans-DIDEUTERIOETHYLENES. Jacob Bigeleisen (Brookhaven National Lab., Upton, N. Y.), Slobodan V. Ribnikar, and W. Alexander Van Hook. J. Am. Chem. Soc., 83: 2956-7(July 5, 1961).

A difference in the vapor pressure of isotopic molecules which is associated with molecular geometry is reported. The vapor pressures of cis- and gem-dideuterioethylene are equal to within a few hundredths of a per cent. The trans compound value is greater than either the cis or the gem by 0.1% at low temperatures and 0.05% at 180°K. (P.C.H.)

25952 SOME DEDUCTIONS FROM A FORMAL STATISTICAL MECHANICAL THEORY OF CHEMICAL KINETICS. John Ross and Peter Mazur (Lorentz Inst. for Theoretical Physics, Leiden). J. Chem. Phys., 35: 19-28(July 1961).

A perturbation solution of an assumed Boltzmann-type equation for bimolecular chemical reactions in a homogeneous gas phase consisting of molecules, with or without internal degrees of freedom, leads to the conclusion that the law of mass action as well as the usually assumed phenomenological rate expressions for chemical reactions, is strictly valid only in lowest order of the perturbation. Higher order perturbations introduce an affinity and time dependence in the rate coefficient and the law of mass action becomes inadequate to the extent of the contribution of the effects of the perturbations. A transition state formulation of rate coefficients for bimolecular gas phase reactions is presented. (auth)

25953 QUANTUM STATISTICAL MECHANICS OF ISOTOPE EFFECTS. I. Oppenheim (National Bureau of Standards, Convair, San Diego, Calif.), and A. S. Friedman. J. Chem. Phys., 35: 35-40(July 1961).

Expansions in powers of Planck's constant are utilized in a discussion of isotope effects on the thermodynamic properties of fluid systems. Theoretical calculations of the differences in the equations of state of the hydrogen isotopes and of the helium isotopes are presented and comparison with experimental results are made. Agreement between theory and experiment is excellent. (auth)

25954 CRYSTAL STRUCTURE OF VANADYL BIS-ACETYLACETONATE. GEOMETRY OF VANADIUM IN FIVEFOLD COORDINATION. Richard P. Dodge, David H. Templeton, and Allan Zalkin (Univ. of California, Berkeley). J. Chem. Phys., 35: 55-67(July 1961). (UCRL-8225(Rev.))

The structure of vanadyl bisacetylacetonate was determined from three-dimensional x-ray diffraction data. The crystals are triclinic, space group P1, with a = 7.53 ± 0.02 A, b = 8.23 ± 0.03 A, c = 11.24 ± 0.04 A, α = 73.0°, β = 71.3°, γ = 66.6°, Z = 2. The structure consists of discrete molecules of $VO(C_5H_7O_2)_2$. Each vanadium atom has five oxygen neighbors at the corners of a rectangular (nearly square) pyramid, with vanadium near its center of gravity. The vanadium–oxygen distances are 1.56 A to the apex atom (vanadyl oxygen) and 1.96, 1.96, 1.97, and 1.98 A to the others. Other bond distances average 1.28 A for C–O, 1.40 A for C–C (ring), and 1.52 A for C–C (methyl). Standard deviations are 0.01 A for V–O bonds and 0.02 A for C–O and C–C bonds. Each acetylacetone skeleton is planar, and this plane makes an angle of 163° with the plane of the other acetylacetone skeleton of the same molecule. (auth)

25955 NOTE ON THE SEPARABILITY THEOREM FOR ELECTRON PAIRS. Per-Olov Löwdin (Uppsala Univ. and Univ. of Florida, Gainesville). J. Chem. Phys., 35: 78-81 (July 1961).

It is shown that, if two functions $A_A(1, 2, 3, \ldots p)$ and $A_B(1, 2', 3', \ldots q')$ describing two groups A and B of electrons are orthogonal with respect to electron 1 then there exists a complete orthonormal set of one-electron functions $\phi_k(1)$ such that the functions actually occurring with non-vanishing coefficients in the expansion of one of the functions cannot simultaneously occur in the expansion of the other function. This is a generalization of a separation theorem. (auth)

25956 SOME EFFECTS OF TEMPERATURE AND VISCOSITY ON FLUORESCENCE AND ENERGY TRANSFER IN SOLUTIONS. A. Weinreb (Argonne National Lab., Ill.). J. Chem. Phys., 35: 91-102(July 1961).

The transfer of excitation energy between molecules of different compounds in solutions is investigated as a func-

tion of temperature and viscosity of the solution. In all cases an increase in transfer efficiency with increasing diffusion is observed. The fluorescence of the donor molecules in the absence of acceptor molecules is studied as a function of temperature and the possible influence of the respective changes on the observed transfer efficiencies is discussed. (auth)

25957 ELECTRONIC STRUCTURE, SPECTRA, AND MAGNETIC PROPERTIES OF OXYCATIONS. III. LIGATION EFFECTS ON THE INFRARED SPECTRUM OF THE URANYL ION. S. P. McGlynn, J. K. Smith, and W. C. Neely (Louisiana State Univ., Baton Rouge). J. Chem. Phys., 35: 105-16(July 1961).

A series of uranyl complexes $K_xUO_2L_y(NO_3)_2$, where L is the variable ligand (or ligands), was prepared; it is shown that a ligand series may be defined using the antisymmetric stretching frequency of the uranyl entity, and this series exhibits a remarkable parallelism with the spectrochemical series defined by Δ in octahedral complexes of transition metals of the 1st and 2nd series. The parallelism was rationalized using a mixed ligand field theory in which the uranyl ion is considered subject to bonding with ligands which are arranged hexagonally in a plane equatorial to the O–U–O axis. It is shown that the large changes of ν_3 and ν_1 are due primarily to electron population of the ϕ_u and δ_u atomic orbitals of uranium. Such population is physically equivalent to the reductions $AmO_2^{++} \rightarrow AmO_2^{+}$ and $NO_2^{++} \rightarrow NpO_2^{+}$, which cause a decrease of approximately 100 cm^{-1} in ν_3. It is further shown that $\Delta\bar{\nu}_3 = -$ electrostatic effect $-\sigma(L \rightarrow M) - \pi(L \rightarrow M) \pm \pi(M \rightarrow L)$, where in the last term the plus sign is the more probable, and the results obtained were rationalized using this equation. Some evidence in favor of linearity of the UO_2^{++} was also induced, and a general criterion for distinguishing the difficulty observable ν_1, was reestablished. It was also shown, although not discussed extensively, that the stability of uranyl complexes should increase, roughly as $\bar{\nu}_3$ (or $\bar{\nu}_1$) decreases. (auth)

25958 GENERAL RELATION BETWEEN POTENTIAL ENERGY AND INTERNUCLEAR DISTANCE FOR DIATOMIC MOLECULES. III. EXCITED STATES. E. R. Lippincott, D. Steele, and P. Caldwell (Univ. of Maryland, College Park). J. Chem. Phys., 35: 123-41(July 1961).

A previously proposed internuclear potential function was used to calculate the dissociation energies for the excited states of a large number of diatomic molecules. From these results and the Wigner-Witmer rules the dissociation products are determined, and it is shown that in many cases it is possible to estimate independently, the dissociation energy of the ground state. The three- and five-parameter forms of the proposed function lead to nearly equal values for dissociation energies suggesting an equivalence of the two forms. This leads to a relation between the anharmonicity and the vibrational-rotational coupling constant which is slightly superior to the Pekeris relation. Equations derived from this relation are given relating the parameters a and b of the five-parameter functions to the anharmonicity or vibrational-rotational coupling constant. The parameter b and to a lesser extent a was found nearly constant for the excited states of all diatomic molecules. (auth)

25959 SOLID-STATE VIBRATIONAL SPECTRA OF THE METHYL AND METHYL-d_3 HALIDES. Marilyn E. Jacox and Robert M. Hexter (Mellon Inst., Pittsburgh). J. Chem. Phys., 35: 183-8(July 1961).

The vibrational fundamentals of solid CH_3Cl, CH_3Br, and CH_3I and of their fully deuterated counter-parts were examined at 77°K under high resolution. CH_3Cl^{35} was synthesized and its ν_3 spectrum compared to that of ordinary CH_3Cl, permitting the assignment of the CH_3Cl^{35} and CH_3Cl^{37} contributions in the ν_3 multiplet structure. The relative intensities of absorption in 1:1 CH_3X:CD_3X solid solutions were measured to test the relationship between splitting, frequency, and absorption intensity predicted by the dipolar correlation model. The test proved to be insensitive. A study of the ν_3 absorption of each component in CH_3Cl: CD_3Cl solid solutions throughout the concentration range shows that multiplet splitting persists at concentrations as low as 1%. (auth)

25960 DISSOCIATION ENERGY OF CYANOGEN AND RELATED QUANTITIES BY X-RAY DENSITOMETRY OF SHOCK WAVES. Herbert T. Knight and John P. Rink (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 35: 199-208(July 1961).

Density ratios across shock waves in a 0.85 Kr + 0.15 C_2N_2 mixture at an initial pressure of 50 mm Hg and room temperature, were determined with an x-ray densitometer as a function of shock velocity. The heat required to dissociate cyanogen into two CN radicals $D(C_2N_2)$ was determined to be 145 ± 6 kcal/mole by comparing the experimental data with curves of density ratio vs shock velocity calculated as a function of $D(C_2N_2)$. Dissociation energies of 174 ± 3 kcal/mole for CN and 129 ± 3 kcal/mole for HCN forming H and CN, and a heat of formation of 109 ± 3 kcal/mole for CN, were obtained by the application of Hess's law to the appropriate chemical reactions using the value of $D(C_2N_2)$ and the currently accepted values for the dissociation energy of nitrogen (225 kcal/mole) and the heat of sublimation of graphite (170 kcal/mole). The value of D(HCN) was confirmed by analogous density-velocity measurements on shock waves in a 0.85 Kr + 0.15 HCN mixture. A rate constant for the recombination of CN to form C_2N_2 at 2900°K was deduced from the variation of density with time behind the shock. The value obtained was the order of 1 ± 10^9(mole/liter)$^{-2}$ sec^{-1}. (auth)

25961 ON THE THEORY OF ION PAIRS IN SOLUTIONS. Jacques C. Poirier and James H. DeLap (Duke Univ., Durham, N. C.). J. Chem. Phys., 35: 213-27(July 1961).

Following the general lines of Fuoss' early analysis, two alternate definitions of ion partners (1) excluding and (2) including partners composed of ions having the same electrical sign are formulated. The resulting sets of coupled integral equations for the ion-partner radial distribution functions $G_{ij}(r)$, differ from Fuoss' by the inclusion of a factor for the probability that the orbital ion does not have a partner closer than the central ion and are valid for electrolytes of any symmetry type or any mixture of electrolytes at any concentration for which the ordinary pair correlation functions $g_{ij}(r)$ for the various types of pairs of ions are known. By the presented iterative numerical method, the set of equations resulting from either definition (1) or (2) may be solved even for a general mixture. Explicit analytical solutions for $G_{ij}(r)$ in terms of an arbitrary (except for an easily relaxed restruction of a hard core) $g_{ij}(r)$ are presented for the following electrolytes: definition (1) symmetrical and unsymmetrical binary; definition (2) symmetrical binary with equal ionic radii. For examples of these electrolytes, graphs of $G_{ij}(r)$ resulting from the use of the Debye-Hückel model and the infinite dilution form of $g_{ij}(r)$ are presented (cations, 10^{-4}M; D = 20; T = 25°C; interionic distance of closest approach, 4.6 A). Numerically obtained $G_{ij}(r)$ are also presented for a 1–1 electrolyte with unequal ionic radii [definition (2); conditions as above except ionic radii

of 1.6 A and 3.0 A] and a mixture of two 1–1 electrolytes with a common anion [definition (1); interionic distance of closest approach of the second electrolyte, 7.0 A]. More extensive ion pair formation of the smaller cation shown in the latter case qualitatively explains anomalously low conductance in mixtures. The $G_{ij}(r)$, markedly smaller than the corresponding Fuoss curve at large separation, lead to the same association constant K^{-1} if the same critical distance is used to terminate the ion pair range; a constant critical distance, however, leads to a K^{-1} which is a continuous function of DT in qualitative agreement with some conductance data and is compatible with a "contact ion pair" concept. An equation for the activity coefficient ratio is presented and degrees of association are calculated in a variety of solutions. The formalism presented easily accepts more realistic $g_{ij}(r)$ functions and can be extended to entirely different types of systems. The usefulness of the ion (or particle) pair approach is briefly discussed. (auth)

25962 RELATIVE BOND STRENGTHS IN TRIGONAL BIPYRAMID MOLECULES. F. A. Cotton (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 35: 228-31 (July 1961). (NYO-9116)

Calculations of the relative strengths of the axial and equatorial bonds in PF_5 and PCl_5 were made using Pauling's criterion of bond strength and using overlap integrals for Slater orbitals as suggested by Mulliken. All calculations were for sp^3d hybridization through the entire range of distribution of s and d character between the axial and equatorial orbitals. The overlap integrals correctly predict that axial bonds are weaker than equatorial ones whereas Pauling's criterion predicts the opposite for all reasonable hybridization conditions. (auth)

25963 INTERMOLECULAR COUPLING OF VIBRATIONS IN MOLECULAR CRYSTALS. II. INTERMOLECULAR FORCES IN CH_3Cl AND CD_3Cl. David A. Dows (Univ. of Southern California, Los Angeles). J. Chem. Phys., 35: 282-7(July 1961).

The effect of isotope substitution on band splittings caused by dipole coupling between molecules is examined. For methyl chloride and methyl bromide, the results support the contention that the theory of dipole coupling in its present form is not sufficient to explain the splittings in most bands. The theory of atom-atom interactions is applied to various possible potentials coupling the motions of normal and deuterated methyl chloride molecules. A repulsive potential acting between hydrogen atoms of neighboring molecules accounts for the splittings of several bands. Certain types of coupling potentials seem ruled out by the results of these calculations, while others are left as possible factors in band shifts which occur when a gas is condensed. (auth)

25964 MOLECULAR ASSOCIATION IN SODIUM CYANIDE VAPOR. Richard F. Porter (Cornell Univ., Ithaca, N. Y.). J. Chem. Phys., 35: 318-22(July 1961).

Mass spectra of vapors from samples of NaCN indicate that the compound evaporates as NaCN(g) and $Na_2(CN)_2(g)$ molecules at temperature around 1000°K. The mass spectrum resembles that obtained for sodium halide and hydroxide vapors. A comparison of relative ion currents produced by electron bombardment of NaCN vapors effusing from single- and double-oven-type Knudsen cells, yielded information related to the processes of ion formation. For the reaction $Na_2(CN)_2(g) = 2\ NaCN(g)$, $\Delta H_{1000°} = 41.0 \pm 3.0$ kcal/mole dimer. A dimer stability comparable to that for Na_2I_2 is indicated. (auth)

25965 SPIN-ORBIT INTERACTIONS IN f^n ELECTRON CONFIGURATIONS. B. G. Wybourne (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 35: 334-9(July 1961).

Simple relationships are shown to exist between the spin-orbit matrix elements of different f^n electron configurations. These relationships allow a great reduction in the labor of calculating the spin-orbit interaction matrices of f^n electron configurations. Several examples are given. (auth)

25966 ELECTROSTATIC ENERGY MATRICES OF THE f^5 and f^6 CONFIGURATIONS. B. G. Wybourne (Univ. of Canterbury, Christchurch, N. Z.). J. Chem. Phys., 35: 340-52(July 1961).

The electrostatic energy matrices of f^5 and f^6 electron configurations are calculated by the Racah methods. Checking rules are used for all the diagonal matrix elements and certain of the nondiagonal matrix elements. (auth)

25967 EFFECT OF PRESSURE ON THE CHARGE TRANSFER SPECTRA OF HEAVY TRANSITION METAL HEXAHALIDE COMPLEXES. A. S. Balchan and H. G. Drickamer (Univ. of Illinois, Urbana). J. Chem. Phys., 35: 356-8(July 1961).

The effect of pressure was measured on the charge transfer bands of seven hexahalide salts of heavy transition metal ions (with 4d and 5d configurations). The lowest energy peaks always exhibited a large red shift with increasing pressure. Higher energy peaks always showed less shift, and in one case actually shifted to the blue. The data are consistent with the assumption of increased spin-orbit coupling at high pressure. The marked broadening of the bands is discussed in terms of the effect of decreased lattice spacing on the molecular charge transfer. (auth)

25968 ELECTRON SPIN RESONANCE SPECTRA OF FREE-RADICAL INTERMEDIATES FORMED BY REACTION OF POLYSTYRENE WITH ATOMS OF HYDROGEN AND DEUTERIUM. R. B. Ingalls (Atomics International, Canoga Park, Calif.) and Leo A. Wall. J. Chem. Phys., 35: 370-1(July 1961).

A method for investigating the reaction of hydrogen and deuterium atoms with polystyrene is described, and the spectra obtained is discussed. By freeze-drying benzene solutions of polystyrene and other polymers, extremely finely divided fibrous fluffs are formed. The technique permits direct observation of free-radical intermediates during a reaction. The differences between the two spectra give evidence that the observed polymer radicals are not produced by abstraction reactions alone. (P.C.H.)

25969 EFFECT OF PRESSURE ON THE ELECTRONIC ABSORPTION SPECTRA OF FERROCENE AND FERRICINIUM ION. J. C. Zahner and H. G. Drickamer (Univ. of Illinois, Urbana). J. Chem. Phys., 35: 375-6(July 1961).

It was observed that a blue shift takes place in the electronic absorption peak near 24000 cm^{-1} of ferrocene, $(C_5H_5)_2Fe$, and its derivatives, $(C_5H_4CH_3)_2Fe$ and $(C_5H_4SO_3Na)_2Fe$. A red shift was observed in the shift of the 16000 cm^{-1} peak in the ferricinium ion in ferricinium fluosilicate. (P.C.H.)

25970 A STUDY OF TRANSFERENCE AND SOLVATION PHENOMENA. III. LITHIUM CHLORIDE IN WATER–ETHANOL AND ETHANOL SOLVENTS. J. O. Wear, C. V. McNully, and E. S. Amis (Univ. of Arkansas, Fayetteville). J. Inorg. & Nuclear Chem., 18: 48-62(Mar. 1961). (In English)

For 99.7 weight per cent ethanol in water the transference number of chloride ion, t_-, in lithium chloride decreases rapidly below a concentration of about 0.40 mole/l. It would have to decrease more rapidly at very low concentrations of salt in this solvent to check the value 0.56 recorded in the literature for t_a in 0.001 to 0.0025 molar solutions of this salt in ethanol. In water t_a decreases rapidly

with concentration of salt in dilute solutions of lithium chloride. The Hittorf transference numbers studied in the strongly ethanolic solvent were limited to the concentration range from 0.0714 to 0.6273 m. A discussion is given of the difference in water and strongly ethanolic solvents of the concentration dependence of t_a and of t_c for lithium chloride. At 1.60 weight per cent lithium chloride a linear decrease of t_a with increased weight per cent ethanol was found. The causes of this increase of the relative mobility of Li^+ compared to Cl^- as the ethanol component of solvent increased is discussed. The grams of solvent transferred from anode to cathode per faraday of electricity at 1.60 weight per cent lithium chloride have a sine wave-like-dependence on the weight per cent ethanol in the solvent. The frequency and the amplitude of the waves increased with increasing weight per cent ethanol. The shape of this curve is given consideration and alternate exchange of successive solvation layers of the Li^+ and Cl^- ions seems to be a plausible explanation. (auth)

25971 HEXACHLOROZIRCONATES. J. E. Drake and G. W. A. Fowles (The University, Southampton, Eng.). J. Inorg. & Nuclear Chem., 18: 136-42(Mar. 1961). (In English)

A number of hexachlorozirconates $[(AH)_2ZrCl_6$, with A = $C_2H_5NH_2$, $(CH_3)_2NH$, $(C_2H_5)_2NH$, $(CH_3)_3N$, and $(C_2H_5)_3N]$ were prepared in a pure anhydrous state, and their thermal stability was examined. These compounds were allowed to react with aliphatic amines. No reaction was observed with tertiary amines, very slow solvolysis occurred with secondary amines, and ethylamine forced the complete replacement of one chlorine atom from the hexachlorozirconate ion. The results are compared with previous studies on zirconium (IV) chloride-amine systems. (auth)

25972 ZIRCONIUM–MANDELIC ACID COMPLEXES IN ETHANOL. T. J. Collopy and J. J. Klingenberg (Xavier Univ., Cincinnati). J. Inorg. & Nuclear Chem., 18: 184-91 (Mar. 1961). (In English)

Spectroscopic data in the range 240 to 270 mμ show that zirconium tetrachloride and mandelic acid react in ethanol to form zirconium tetramandelate. Similar reactions occurred when p-chloromandelic acid and p-bromomandelic acid were used. (auth)

25973 ASSOCIATION OF URANIUM(VI) WITH ANIONS IN AQUEOUS PERCHLORIC ACID MEDIUM. D. Banerjea and K. K. Tripathi (Indian Assn. for the Cultivation of Science, Calcutta). J. Inorg. & Nuclear Chem., 18: 199-206(Mar. 1961). (In English)

From a study of the equilibrium distribution of UO_2^{2+} ion as a function of ligand concentration between resin (Amberlite IR-120, sodium form) and aqueous phases at pH 3 and ionic strength 1M in $HClO_4$-$NaClO_4$ solutions, the formulas and formation constants (at 32°C) of the complexes formed by UO_2^{2+} ion with the anionic ligands chloride, nitrate, thiocyanate, and sulfate were determined by making use of a simple graphical method. In the case of nitrate and thiocyanate ions, species with UO_2^{2+}: ligand ratios of 1:1, 1:2, and 1:3 seem to be formed, while sulfate appears to form only 1:1 and 1:2 complexes. In the case of chloride ion, however, only the 1:1 species exists even when (Cl^-): (UO_2^{2+}) = 1000:1. Over-all formation constants of the various complexes are as follows:

β_1: Cl^-, 2; NO_3^-, 0.04; SCN^-, 0.05; SO_4^{2-}, 43.

β_2: NO_3^-, 0.04; SCN^-, 11.2; SO_4^{2-}, 6×10^3

β_3: NO_3^-, 0.32; SCN^-, 12. (auth)

Analytical Procedures

25974 (AERE-AM-75) THE DETERMINATION OF URANIUM ALPHA RADIOACTIVITY IN AQUEOUS SOLUTIONS. C. G. Wallace (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). June 1961. 5p.

Uranium is precipitated at pH 7.5 with tannic acid and hexamine. After wet destruction of organic material, the residue is transferred to stainless steel counting discs, and the activity determined in α scintillation or proportional counters. (auth)

25975 (AERE-AM-76) THE DETERMINATION OF THORIUM ALPHA-ACTIVITY AND OF ZIRCONIUM, CERIUM AND RARE EARTH BETA-ACTIVITIES IN SOLUTIONS CONTAINING ALUMINIUM. C. G. Wallace (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). June 1961. 12p.

Aluminium is removed as soluble aluminate with sodium hydroxide solution. Thorium is co-precipitated with zirconium iodate and subsequently separated from the latter in fluoride solution. Zirconium, after hydrolysis of its fluoride complex with sodium hydroxide, is precipitated as the mandelate. Cerium and the rare earths are separated in iodate solution and are finally precipitated as oxalates. (auth)

25976 (AERE-R-3498) THE PRECIPITATION OF MICRO QUANTITIES OF URANIUM WITH TANNIC ACID AND HEXAMINE. C. G. Wallace (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). June 1961. 8p.

Uranium(VI) present in aqueous solution in concentrations ranging from 0.025 to 1μg/ml is precipitated with tannic acid and hexamine. After wet destruction of the organic matter the residue is transferred to counting discs and the α activity determined in low background counters. The recovery is 97 ± 5%, and the procedure is applicable also to thorium and plutonium. The precipitation is not affected by the presence of sulphonate and ammine type emulsifying agents. Evidence is recorded of the existence of small amounts of uranium α activity in some chemical reagent materials. (auth)

25977 (CEA-1885) UNE MÉTHODE DE DOSAGE DE L' URANIUM 233 CONTENU DANS UN BARREAU DE THORIUM IRRADIE. (A Method for the Quantitative Determination of Uranium-233 in an Irradiated Thorium Rod.) A. Bathellier, R. Sontag, and A. Chesne (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 13p.

For presentation at the 32nd International Congress on Industrial Chemistry, Barcelona, Oct. 1960.

A 30% solution of trilaurylamin in xylene is used to extract the uranium from an aqueous hydrochloric acid solution and separate it from the thorium. This may be followed by α counting or fluorimetry. The practical operating conditions of the separation are discussed in detail. (auth)

25978 (CEA-1962) DOSAGES PAR CHROMATOGRAPHIE EN PHASE GAZEUSE DE MELANGES D'HYDROGENE, D'HYDROGENE DEUTERE, DE DEUTERIUM ET DE MELANGES ORTHO-PARA-HYDROGENE. (Isotopic Analysis of H_2, HD, D_2 Mixtures and Analysis of Ortho-Para-Hydrogen Mixtures by Gas Chromatography.) F. Botter, G. de la Perriere, and S. Tistchenko (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 51p.

The possibilities of vapor phase chromatography for the separation and analysis of mixtures of H_2, HD, and D_2, and of ortho- and para-hydrogen mixtures are described. Separation factors for physical adsorption of the various varieties of hydrogen were deduced from chromatograms and were also measured directly with a static method. The agreements are good. (auth)

25979 (CISE-87) TECHNICHE, APPARECCHIATURE E DATI SPERIMENTALI PER L' ANALISI CHIMICA E RADIOCHIMICA. 7. – STUDI SU ALCUNI MINERALI CONTENENTI URANIO (E TORIO): METODI DI ATTACCO, SEPARAZIONI CHIMICHE, ANALISI. (Techniques, Procedures and Experimental Data for Chemical and Radiochemical Analysis. 7. Studies on Some Minerals Containing Uranium (and Thorium): Methods of Dissolution, Chemical Separation, Analysis). E. Cerrai, F. Gazzarrini, and C. Giacoletto (Centro Informazioni Studi Esperienze, Milan). Apr. 1961. 46p.

Various types of minerals containing uranium and thorium were examined. For each type of mineral, the experimental methods of attack and the various schemes adopted for the separation of uranium and thorium from other elements, as well as the relative methods of determination, are given. In particular the separation methods for U–Th–Zr and U–Th–Ti are described. (tr-auth)

25980 (CNI-62) DETERMINAZIONE POLAROMETRICA DI O_2 e H_2O_2 DISCIOLTI IN ACQUA. (Polarometric Determination of O_2 and H_2O_2 Dissolved in Water). G. Barbi (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). Mar. 1961. 16p.

A polarometric method for the separate determination of small quantities of oxygen and hydrogen peroxide in water was developed. Oxygen can be determined in quantities more than 1 ppm with an accuracy of ±3% and between 0.4 and 1 ppm with ±5% even in presence of amounts of hydrogen peroxide of 100 ppm. Hydrogen peroxide can be determined in concentrations between 5 and 120 ppm with an accuracy of ±5%. (auth)

25981 (DP-572) IN-LINE POLAROGRAPHY OF URANIUM IN PROCESS WASTE. Robert C. Propst (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1961. Contract AT(07-2)-1. 25p.

A polarographic method was developed that can be applied to the in-line determination of uranium in Purex process wastes. Interference from iron(III) and nitrite was eliminated by the addition of ascorbic acid to the sample. A prototype monitor was successfully demonstrated in the laboratory, monitoring uranium in synthetic waste at concentrations of 10^{-5} to 10^{-4} molar. (auth)

25982 (DP-578) COLORIMETRIC DETERMINATION OF URANIUM(IV). Robert S. Dorsett (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). May 1961. Contract AT(07-2)-1. 9p.

A colorimetric method was developed for the determination of uranium(IV) in the presence of uranium(VI), nitric acid, hydroxylamine sulfate, and hydrazine. A coefficient of variation of 2.4% (n = 25) was obtained. (auth)

25983 (HW-59749) THE ANALYSIS OF EXHAUST PRODUCTS IN THE CHLORINATION OF PLUTONIUM OXIDE WITH PHOSGENE. L. F. Lust (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 24, 1959. Decl. (?). Contract W-31-109-Eng-52. 14p.

Conventional analytical methods were adapted to the analysis of exhaust gases from the chlorination of PuO_2 with phosgene gas. Exhaust gases from chlorination of Ce and Pu oxides were found to contain CO_2, Cl_2, CO, and unreacted phosgene. The analyses were carried out using a modified Orsat apparatus with KOH for absorbing CO_2 and $COCl_2$, a commercial O_2 absorbent, ammoniacal Cu_2Cl_2 solution for CO, and a NaI solution in acetone for $COCl_2$ absorption. Two aliquots are required since $COCl_2$ is absorbed with CO_2. (J.R.D.)

25984 (HW-69199) SPECTROCHEMICAL ANALYSIS OF HIGH PURITY PLUTONIUM FOR METAL IMPURITIES USING ANION EXCHANGE. Roy Ko (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 11, 1961. 7p.

The ion-exchange–spectrographic determination of impurities in plutonium was extended to cover the range 0 to 10 ppm. Fe, Ni, Cr, Ca, and Mn were determined below 1 ppm and Mg and Zn below 10 ppm. Plutonium was separated by adsorption of the nitrate complex on Dowex 1. The metal impurities were not adsorbed. The residue from evaporation of the solution was analyzed by d-c arc excitation. A coefficient of variation of ±14% at the 2 ppm level was estimated. The accuracy was within the precision of the measurements. (auth)

25985 (PAN-199/XIII) SPEKTROGRAPHISCHE ANALYSE RADIOAKTIVER LÖSUNGEN. (Spectrographic Analysis of Radioactive Solutions). J. Fijalkowski and R. Plejewski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1960. 13p.

Carrying out spectral analyses of radioactive materials necessitates complete protection against the effect of radioactivity. In the present work, the apparatus for the performance of spectrographic analyses, with the copper spark method, on beta- and gamma-active solutions is described. This apparatus was constructed in the Isotope Technology Division. (tr-auth)

25986 (PG-Report-172) THE DETERMINATION OF IMPURITIES IN BERYLLIUM BY ACTIVATION ANALYSIS USING REMOTE REACTOR FACILITIES. A. P. Seyfang and R. Todd (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1961. 29p.

The procedure used and the equipment required for the determination of impurities in beryllium by reactor neutron activation analysis are described, and it is pointed out that laboratories concerned with the analysis of beryllium are favorably placed to take up this important method of analysis. The precision and the sensitivities attainable working away from a reactor are discussed, and interfering processes are treated in some detail. (auth)

25987 (PG-Report-206) ANALYTICAL METHOD FOR THE DETERMINATION OF YTTRIUM-90 AND LANTHANIDE FISSION PRODUCTS IN REACTOR FUEL PROCESSING AND EFFLUENT TREATMENT PLANT SOLUTIONS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1961. 7p.

Yttrium-90 and radio lanthanides are co-precipitated with lanthanum as fluorides, purified by hydroxide precipitations, and their β activities are measured from a mounted oxalate precipitate. (P.C.H.)

25988 (PG-Report-210) ANALYTICAL METHOD FOR THE DETERMINATION OF PLUTONIUM IN THE FEED AND PRODUCT SOLUTIONS OF THE WINDSCALE PRIMARY SEPARATION PLANT (COMPLEXOMETRIC TITRATION). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1961. 11p.

The sample solution is mixed with a solution of hyamine 1622 in benzene. Plutonium is extracted. Fission products and the bulk of other elements such as iron, chromium, and uranium are not extracted. The solvent is evaporated and the plutonium is complexed with ethylene diaminetetraacetic acid, the excess of which is back titrated with standard zinc chloride to a photometric end point. (auth)

25989 (PWAC-340) METHODS FOR THE ANALYSIS OF COLUMBIUM AND ITS ALLOYS. E. W. Hobart and D. E. Fornwalt, eds. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). June 30, 1961. Contract AT(11-1)-229. 56p.

Analytical procedures modified or developed for the determination of alloying constituents and impurities in Nb and its alloys are presented. Included are spectrophotometric methods for Cr, Nb, Fe, Mo, W, Ni, N, and Ti; volumetric methods for Cr, V, and Zr; emission and x ray spectrographic methods for various alloying elements; a spectrographic method for Zr and trace impurities and miscellaneous methods for Al, C, O, and H. (auth)

25990 (SCR-420(p.87-96)) ADEQUACY OF RADIOASSAY TECHNIQUES; ALTERNATE ASSAY METHODS. (Discussion).

A panel discussion is presented on radioassay techniques for bomb debris in the atmosphere. Some of the topics discussed are: tungsten isotopes, calibrations, sensitivities, sampling volumes, mass spectrometry, burnup of re-entry vehicles, and neutron activation. (D.L.C.)

25991 (Y-1357) DETERMINATION OF URANIUM AND YTTRIUM IN BERYLLIUM OXIDE BY X-RAY FLUORESCENCE. G. E. Walden (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Aug. 3, 1961. Contract W-7405-eng-26. 17p.

X-ray spectroscopy was successfully applied to the determination of 1 to 10% uranium and 1 to 12% yttrium in beryllium oxide using rubidium as a common internal standard. Analyses were performed on pellets which had been prepared by pressing a mixture of sample and cornstarch. Limits of error (0.95) for uranium determinations varied from ±4% at the 1% level to ±2.8% at the 9% level, and for yttrium from ±7.5% at the 1% level to ±2.5% at the 12% level. (auth)

25992 (AEC-tr-4482(p.404-9)) RADIOACTIVATION ANALYSIS OF HAFNIUM IN ZIRCONIUM. T. Okada, T. Nishi, and C. Matsumoto.

The neutron activation method of analysis was used to determine the amount of hafnium in zirconium oxide. It was found that hafnium can be analyzed with good precision in concentrations as low as 100 ppm. Manganese was used as the internal standard sample. (M.C.G.)

25993 (AEC-tr-4482(p.410-22)) ANALYSIS OF Hg IN PLANTS BY THE ISOTOPE DILUTION METHOD. N. Suzuku.

The isotope dilution method was applied to the determination of mercury in plants. The effects of acidity on the extraction with dithizone, the ratio between mercury and dithizone, the effects of silver and copper in coexistence, the stability of mercury dithizone in dilute ammonia, and the decomposition of mercury dithizone salts with a mixture of H_2SO_4 and HNO_3 are discussed. Results for the determination of mercury in rice are presented. (M.C.G.)

25994 (AEC-tr-4482(p.1388-1404)) DETERMINATION OF AMINO ACIDS BY THE COMBINATION OF CHROMATOGRAPHY AND ISOTOPE DILUTION METHODS. T. Wada.

The determination of amino acids of several proteins using a combination of chromatography and isotope dilution methods is described. To the hydrolysate of protein, C^{14}-labeled amino acids, corresponding to the acids contained in the protein, were added. Then they were separated by electrophoresis into the acidic, neutral, and basic fractions. Paper chromatography was applied to each fraction. The separated amino acids were extracted from the filter paper, and their contents were determined by the measurement of the extinction coefficient of ninhydrin color and radioactivity. The error of this determination was within ±10%. If the ratio of the original sample and the C^{14} labeled amino acid is known accurately, the result is not affected by the loss of material during the experiment. (M.C.G.)

25995 DETERMINATION OF ZIRCONIUM USING A TITRIMETRIC METHOD. Theo Boethin, Franz Matthes, and Roman Rybak (VEB Elektrochemisches Kombinat, Bitterfeld, Ger. and Technische Hochschule Chemie, Leuna-Merseburg, Ger.). Chem. Tech. (Leipzig), 13: 306-7 (May 1961). (In German)

The possibility of the titrimetric determination of zirconium was investigated. Since the analysis of zirconium silicates is of special importance, a decomposition method was discussed which appears suitable to clarify the reaction path. The application of the method and the accuracy obtainable was given. (tr-auth)

25996 PRELIMINARY STUDY OF THE DETERMINATION OF ELEMENTS BY NEUTRON ACTIVATION, BASED ON THE FORMATION OF SHORT-LIVED ISOTOPES: RAPID SEPARATION AND DETERMINATION OF LOSSES. D. Monnier, W. Haerdi, and J. Vogel (Université, Geneva). Helv. Chim. Acta, 44: 897-903(1961). (In French)

A method for the rapid separation of cobalt by toluene extraction of its β-nitroso-α-naphthol complex with estimation of the losses involved is presented. Iron, the chief element causing disturbance in assay by gamma spectrometry (Co^{60}) after activation, gives a complex with sodium fluoride-acetate-citrate in a medium at pH 5 to 6 and remains quantitatively in the aqueous phase. In this way it has been possible to separate 0.1 μg of cobalt in the presence of 100 mg of iron. The estimation of losses is carried out by means of a radioactive tracer (Co^{58}). The time necessary for separation and estimation is about 20 min and would thus permit a cobalt assay based on that of the Co^{60m} (period 10.5 min) which is formed by activation. A chemical method for the control of losses was studied. (auth)

25997 INORGANIC THIN LAYER CHROMATOGRAPHY. II. DETECTION OF U^{6+} AND Ga^{3+} IN CATION MIXTURES. H. Seiler and M. Seiler (Universität, Basel). Helv. Chim. Acta, 44: 939-41(1961). (In German)

The thin layer method is applied to the chromatographic separation and identification of UO_2^{2+} from other cations, and of Ga^{3+} from Al^{3+}. (auth)

25998 THE DETERMINATION OF Cu, Cr, Zn AND Co IN THE SERUM BY RADIOACTIVATION. J. Pijck, J. Gillis, and J. Hoste (Université, Gent). Intern. J. Appl. Radiation and Isotopes, 10: 149-57(July 1961). (In German)

The results of investigations dealing with the loss of trace quantities of the elements Sb, As, Cr, Co, Au, Fe, Cu, Hg, Pb, Mn, Mo, V, Ag, and Zn during destruction of biological material, prior to their determination by radioactivation analysis, is summarized as follows: dry destruction by ignition is to be rejected as a general method as many of the metals investigated are lost to a considerable extent, even at relatively low temperatures of 500–550°C. With a

liquid destruction mixture of $HNO_3-H_2SO_4-HClO_4$ in a ratio of 3:1:1, complete recovery can be obtained for all of the elements investigated, excepting Sb, As, Au, Fe, and Hg. These can be quantitatively recovered if an efficient reflux condenser is used. A number of possibly interfering (n,p) and (n,α) reactions, due to fast neutrons, were investigated, namely: $Zn^{64}(n,p)Cu^{64}$; $Fe^{54}(n,\alpha)Cr^{51}$; $Ni^{58}(n,p)Co^{58}$. Interference was proved to be less than 1% when irradiated in BR 1 at a flux of 5×10^{11} n/cm² sec. Finally, trace quantities of the elements Cu, Cr, Zn, and Co were determined in blood-serum by radioactivation analysis. Wherever possible, selective extraction methods were used. Results from series of determinations, which were compared with reliable spectrophotometric data, proved to be accurate and reproducible, whereas sampling could be kept down to the 25–250 λ range. (auth)

25999 DETERMINATION OF GASES IN METALS BY VACUUM FUSION. J. E. Still (General Electric Co. Ltd., Wembley, Eng.). Iron Steel Inst. (London), Spec. Rept. No. 68, 43-63(1960).

The gas contents of various less common metals were determined, including titanium, zirconium, molybdenum, and beryllium. Apparatus is described for vacuum fusion, using both iron and platinum baths. It is designed for simplicity of operation and versatility in research investigations rather than for routine analysis. A number of useful safety features are incorporated. (auth)

26000 NEUTRON ACTIVATION ANALYSIS: THE DETERMINATION OF MANGANESE. P. S. Papavasiliou and George C. Cotzias (Brookhaven National Lab., Upton, N. Y.). J. Biol. Chem., 236: 2365-9(Aug. 1961). (BNL-5173)

Criteria pertaining to biochemical applications of neutron activation analysis were formulated and dealt with experimentally. An ultramicromethod was described which permits the determination of the essential microconstituent, manganese, in biological samples, including small pools with low concentrations. Samples containing, on the average, 0.261 mμg of manganese were analyzed with a variance of ±3.4%. The mean concentration of manganese in human plasma was 2.69 μg per liter. The plasma concentration remained constant in the rabbit after injections of manganous sulfate whereas that of whole blood increased. Manganese concentrations were determined in some tissues and in some reagents. (auth)

26001 CHROMIUM, URANIUM, TUNGSTEN AND NICKEL COMPLEXES OF THIOGLYCOLIC ACID. V. M. Bruchar (National Physical Lab., New Delhi, India). Nature, 191: 489-90(July 29, 1961).

The effects of pH and the interference of other ions in the colorimetric and polarographic determination of Cr, W, U, and Ni in complexes with thioglycolic acid are discussed. Data are tabulated and presented graphically. (C.H.)

26002 MASS-SPECTROMETER ANALYSES OF RADIOCARBON STANDARDS. Harmon Craig (Univ. of California, La Jolla). Radiocarbon, 3: 1-3(1961).

Twenty-four samples of CO_2, from combustion of a National Bureau of Standards oxalic acid radiocarbon standard, were analyzed for C^{13} in order to provide comparative data for normalizing the counting results. Data are tabulated on the content of C^{13} and O^{18}. (C.H.)

26003 STUDIES ON URANIUM CARBIDES. I. CHEMICAL ANALYSIS OF URANIUM CARBIDES. Tetsuzo Atoda, Yasuo Takahashi, Yoshihiko Sasa, Iwami Higashi, and Masayoshi Kobayashi. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: 73-82(June 1961). (In English)

Compounds produced in the uranium carbide production process, which is started from thermal decomposition of uranyl nitrate hexahydrate and followed by carbothermic reduction of uranouranic oxide, are analyzed. The compounds are grouped into oxide and carbide systems. Constituents of the oxide system are successfully analyzed by determining total and quadrivalent uranium volumetrically. For the carbide system, total uranium is determined by the same method as used for the oxide system and total and free carbon by the combustion method; combined carbon is obtained as the difference between the two. Standard deviations of the determined values for all the elements by the analytical method, every element being determined five times, are ±0.1 (%) in total uranium, ±0.05 (%) in total carbon and ±0.02 (%) in free carbon. Some properties of uranium carbides are also presented. (auth)

26004 COMPLEXOMETRIC METHOD OF DETERMINING THORIUM AND ZIRCONIUM IN MAGNESIUM ALLOYS. R. S. Volodarskaya. Zavodskaya Lab., 26: 925-7(1960). (In Russian)

Arsenazo was found to be best for the complexometric determination of thorium. Thorium and arsenazo form a colored complex which is stable also in acid solutions, and which does not form complexes with Mg, Zn, Cd, Mn, Ca, and rare earths. One molecule of Trilon B forms a complex with one molecule of Th. Magnesium alloys, containing up to 4% of Th and 1% of Zr, were analyzed with this indicator. Larger quantities of Mg, Zn, Al, Mn, Cd, Ce^{3+}, Nd, Pr, and La do not affect the thorium titration. The color transition is not affected by a content of up to 0.02% of Cu, 0.5% of Ni, and 0.1% of Pb. Before the titration Ce^{4+} must be reduced by ascorbic acid. Zr interferes and cannot be masked by additions of citric and tartaric acids, since at the same time thorium also forms a complex. The precipitation of Zr by the five-fold amount of phenylarsonic acid was successful. The analyses of alloys with and without zirconium are described. The back-titration of the Trilon excess at a pH of 2.0–2.5 by an iron chloride solution in the presence of sulfosalicylic acid, was used for the determination of zirconium in magnesium alloys. Mg, Ag, Cd, Zn, Al, Mn, Nd, La, and Pr do not interfere, while titration is found to be impossible in the presence of Th. At a pH of 2.0–2.5 Trilon B and thorium form a complex which is destroyed by iron. An addition of iron chloride makes the pink color of the iron sulfosalicylate disappear quickly even without Trilon excess. This is also the case in the titration of thorium alone. Therefore, it is necessary that zirconium be precipitated by a 10% phenylarsonic acid solution in the presence of thorium in the alloy, the precipitation be dissolved after fusion, and the zirconium be determined by complexometric titration. Trilon must be added to a strongly acid, hot zirconium solution containing approximately 20% of HCl. For the complex formation, the solution then must be boiled for some minutes. Solutions which are warm, but not necessarily hot, can be titrated. For one molecule of Trilon B one zirconium atom is used. The analysis is described in detail. (OTS)

26005 DETERMINATION OF ALKALI METALS AND HALOGENS IN ZIRCONIUM DIOXIDE BY HIGH-VOLTAGE ELECTRODIALYSIS. S. V. Yelinson and A. T. Rezova. Zavodskaya Lab., 26: 1209-10(1960). (In Russian)

A device consisting of an electrodialyzer of the Pauli type with a BBC-1 (VVS 1) rectifier and the corresponding controlling and measuring instruments may be used to separate potassium. A voltage up to 2000 v and an amperage up to 300 ma may be attained. The electrode chambers are separated by a cellophane membrane which is permeable for the electrolyte. Platinum electrodes are used and a

stirrer is fitted in the central chamber. The completeness of the potassium and fluorine separation was checked on artificial ZrC_2 samples. It was found that at high potassium content the liquid in the electrode chambers must be changed 2–3 times. The final determination of the separated potassium was made gravimetrically with tetraphenyl borate, that of fluorine was performed colorimetrically or in the form of PbClF. (OTS)

26006 DOSIMETRY OF TRITIUM IN THE ATMOSPHERE. G. Soudain, P. Blanchard, and A. Chapuis (Centre d'Etudes Nucléaires, Saclay, France). p.203-11 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In French)

Described is an apparatus designed for determining the amount of tritium continuously present in the atmosphere. It consists of two chambers mounted in opposition, the current of tritium-contaminated air passing through one of them. The internal wall of the measuring chamber is gilded to prevent adsorption of the tritiated gas. The ionization current is measured by means of a vibrating-condenser electrometer. The operation and calibration of the apparatus are described. (auth)

26007 A METHOD OF DETECTING PLUTONIUM BY GAMMA SPECTROGRAPHY AT 17 kev; APPLICATION TO THE MEASUREMENT OF RADIOACTIVE CONTAMINATION IN MAN. M. Trouble (Centre d'Etudes Nucléaires, Saclay, France). p.237-41 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In French)

Pu^{239} emits gamma radiation in an energy range centered around 17 kev, the activity being about 0.06c/g Pu. The emission is sufficient to allow measurement of superficial or near-surface contamination in man, sensitive enough to detect amounts of Pu much below the permissible doses. The detector used is either a proportional gas counter, or a very thin NaI(Tl) or CsI(Tl) crystal. The measurements are made in a shielded enclosure; the detector is used in conjunction with a multi-channel selector. (auth)

26008 SOLUTIONS FOR RADIOACTIVE DECONTAMINATION. (to Bendix Corp.). British Patent 875,762. Aug. 23, 1961.

A decontaminating solution is described which is capable of direct action on the contaminants as well as the associated soil and which may be used to decontaminate inexpensive hand tools. The solution is comprised of ethylenediaminetetraacetic acid; sodium sulfide, carbonate, and/or sulfate; sodium hydroxide; and an adsorbent material. The adsorbent material may be selected from the group of silicate earths, arsenic or antimony sulfide, diatomaceous earth, chalk, carbon black, and metal oxides. The article to be decontaminated is immersed in the solution under ultrasonic cavitation. (D.L.C.)

General Inorganic and Physical Chemistry

26009 (AERE/EMR/PR-1044) STUDIES ON ALKOXIDES AND ALKYLSILYLOXIDES OF URANIUM (thesis). Ramesh Narain Kapoor (London. Univ. Birkbeck Coll.). Oct. 1960. 157p.

The preparation and properties are reported for a range of alkoxides and trialkylsilyloxides of quadrivalent, quinquevalent, and sexivalent uranium. Molecular weights were measured ebulliscopically in benzene, and structures are proposed for the polymeric species. The following new compounds were prepared: alcoholates of uranium tetrachloride with the general formula UCl, 4ROH where R = Me, Et, and Pr^i by reaction between uranium tetrachloride and the appropriate alcohol; the uranium tetraalkoxides $U(OR)_4$ where R = Pr^n and Pr^i, by the action of either lithium alkoxide or sodium alkoxide on uranium tetrachloride, $UCl_4 + 4LiOR = U(OR)_4 + 4LiCl$; the uranium penta-alkoxides $U(OR)_5$ where R = Bu^i, Am^i, Am^{sec}, Am^{neo}, Bu^s, $CHMePr^n$, $CHMePr^i$, $CHEt_2$, Bu^t, Am^t, CMe_2Pr^n, $CMePr^i$, $CMeEt_2$, $CMeEtPr^i$, and CEt_3 by the alcoholysis of uranium pentaethoxide, $U(OEt)_5 + 5\ ROH = U(OR)_5 + 5\ EtOH$; the solvated compounds $U(OBu^t)_5$, Bu^tOH, and $U(OBu^t)_5$, C_5H_5N; the mixed alkoxides $U(OEt)(OBu^t)_4$ and $U(OEt)_2(OBu^t)_3$; the uranium pentakis-trialkylsilyloxides $U(OSiR_3)_5$ where R_3 = Me_3, Me_2Et, $MeEt_2$, and Et_3 by the silanolysis of uranium pentaethoxide; uranium hexa-t-amyloxide $U(OAm^t)_6$ by alcoholysis; and the uranium hexakis-trialkulsilyloxides $U(OSiR_3)_6$ where R_3 = Me_3, Me_2Et, $MeEt_2$, and Et_3 by the silanolysis of uranium hexaethoxide. (auth)

26010 (AERE/X/PR-2510/16) THE REACTION OF BERYLLIUM AND SOME OTHER METALS WITH CARBON DIOXIDE AT ELEVATED TEMPERATURES (thesis). R. J. Hussey (Exeter, England. Univ.). 1960. 180p.

The chemistry and kinetics of the reaction of French Flake beryllium with CO_2 CO–CO_2 mixtures, and CO were investigated at 500 to 750°C by means of a radiotracer technique and on a microbalance. It was concluded that the following reactions occur: $Be + CO_2 = BeO + CO$, $2Be + CO_2 = 2BeO + C$, and $Be + CO = BeO + C$. It is believed that the beryllium carbide present in the oxide layer is formed by the reaction: $2Be + C = Be_2C$. Kinetic results show that the oxidation is protective at temperatures up to 700°C; at 750°C, however, breakaway occurs. If the CO_2 is admitted to the preheated sample, the reaction is very rapid at first and most of the carbon is deposited over this initial period. In CO, the oxidation is non-protective above 550°C, while in CO–CO_2 mixtures containing up to 7.5% CO, the kinetics are the same as in CO_2 alone. The kinetics of the reaction of zirconium with CO_2 was investigated at temperatures of 550, 650, and 750°C on the microbalance. The reaction $Zr + 2CO_2 = ZrO_2 + 2CO$ is predominant at all three temperatures, and in each case the rate of reaction first decreases and then increases with time indicating breakway. (P.C.H.)

26011 (CEA-1847) PROPRIETES CHIMIQUES ET ELECTROCHIMIQUES DANS L' EUTECTIQUE CHLORURE DE LITHIUM-CHLORURE DE POTASSIUM FONDU. (Chemical and Electrochemical Properties in the Molten Lithium Chloride–Potassium Chloride Eutectic.) Guy Delarue (France. Commissariat a l'Energie Atomique. Centre d'Études Nucléaires, Saclay). 1961. 74p.

Thesis submitted to Univ. of Paris.

The solubility of certain oxides and sulphides made it possible to show the existence of O^{2-} and S^{2-} ions. The existence of a certain number of chemical reactions: oxydo-reduction precipitation, complex formation, the oxidation of O^{2-} and S^{2-} are shown. 144 references are included. (auth)

26012 (NP-10456) ANALYSIS OF HIGH RESOLUTION ABSORPTION SPECTRA OF THE U^{+4} ION IN CRYSTALS. Technical Report No. 2. S. A. Pollack (California. Univ., Los Angeles). Nov. 1960. Contract DA-04-495-ORD-1375. 184p. ([OOR-2099.4])

The vibronic spectra of three related U^{4+} crystalline salts, ditetramethyl ammonium- (TMA), ditetraethyl ammonium- (TEA), and dicesium uranium hexachloride, are reported and interpreted, both from the point of view of a single UCl_6^{2-} complex in a crystalline field and from the

viewpoint that the modes must be those of the entire crystal. The three strongest vibronic bands (20-30 cm^{-1} wide) associated with each electronic transition is explained as due to electric dipole transitions involving, along with a change in electronic state, a simultaneous change of one quantum of an odd vibrational mode of a single UCl_6^{2-} complex. In higher dispersion the three strong bands associated with the odd modes of the complex are found to have structures visible at low temperatures. Other features are: the demonstration of the influence of imperfections on destroying inversion site symmetry and permitting pure electronic electric dipole transitions; the presence of possibly metastable lattice vibrational levels (optical modes) at liquid helium temperature; and the confirmation of a number of spectral features previously reported. (P.C.H.)

26013 (NYO-7123) THE PREPARATION AND PROPERTIES OF THE $(C_5H_5)_2M$ COMPOUNDS OF MANGANESE AND RHENIUM. PART I. MANGANESE CYCLOPENTADIENIDE. G. Wilkinson, J. M. Birmingham, and F. A. Cotton (Harvard Univ., Cambridge, Mass.). Mar. 3, 1955. Contract AT(30-1)-1461. 44p.

The compound $(C_5H_5)_2Mn$ was prepared by the reaction of the halide with C_5H_5Na in tetrahydrofuran or ethyleneglycol dimethylether solution; the chemical and physical properties are described. The magnetic susceptibility of $(C_5H_5)_2Mn$ was measured over the range 77 to 530°K; it shows antiferromagnetic behavior with a Neel temperature of 134°K and there is a sharp susceptibility and color transition at 432°K associated with complete destruction of cooperative phenomena existing in the crystal. The latter are also removed by magnetic dilution. The compound is shown to be ionic in nature by the magnetic studies and also by other evidence such as conductivity studies in liquid ammonia solution. Magnesium cyclopentadienide, $(C_5H_5)_2Mg$, is also described, and improved preparative methods for $(C_5H_5)_2V$, $(C_5H_5)_2Cr$, and $(C_5H_5)_2Co$ are given. The chemical reactivities of the $(C_5H_5)_2M$ compounds of V, Cr, Mn, Fe, Co, Ni, and Mg and of C_5H_5Na are compared. Evidence for ionic behavior of $(C_5H_5)_2V$ and $(C_5H_5)_2Cr$ is discussed. (auth)

26014 (TID-13338) LOW TEMPERATURE CHEMICAL THERMODYNAMICS OF THE LANTHANIDE SESQUIOXIDES. (Cover carries title: THERMAL AND ELECTRONIC PROPERTIES OF THE RARE EARTH OXIDES). Edgar F. Westrum, Jr. and Bruce H. Justice (Michigan. Univ., Ann Arbor). [1961]. 35p.

Heat capacities and thermal properties of ten rare earth sesquioxides lead to assignment of several Stark levels and to a tentative evaluation of the electronic entropies. Measurements on flame-fused oxides are being used to extend the measurements to lower temperatures and improve the certitude of the analysis and the thermodynamic functions. (auth)

26015 (UCRL-9723) THE HEAT CAPACITY OF SILVER OXIDE AT LOW TEMPERATURES (thesis). Lawrence Vincent Gregor (California. Univ., Berkeley. Lawrence Radiation Lab.). May 31, 1961. Contract W-7405-eng-48. 105p.

The heat capacity of Ag_2O was measured from 2.2 to 80°K for a finely divided annealed sample, and from 3.3 to 24°K for a macrocrystalline annealed sample. The anomalously high heat capacity originally observed in unannealed Ag_2O between 20 and 50°K is also found in the finely divided sample, though the anomalous region is smaller and narrower, and its maximum occurs at a lower temperature. No anomalous peak in the heat capacity of macrocrystalline Ag_2O is observed down to 3.3°K, but the heat capacity of this material is higher below 14°K than that of the finely divided sample. The heat capacity of the various samples of Ag_2O is discussed in terms of its unusual crystal structure, and a mechanism is proposed to correlate the anomalous behavior of Ag_2O below 15°K and between 20 and 40°K. The mechanism involves the interaction of the two independent sublattices of the structure of Ag_2O, and it is proposed that for very small particles there is a transition from a symmetric high-temperature structure to a slightly distorted low-temperature structure in the vicinity of 20 to 30°K. Revised values of the thermodynamic properties of macrocrystalline Ag_2O at 298.15°K are given, based on the observed heat capacity data below 15°K. The results are: $S^0_{298.15} = 28.91 \pm 0.07$ cal deg^{-1} $mole^{-1}$; $H^0_{298.15} = 3387 \pm 5$ cal $mole^{-1}$; and $(-F^0 - H^0_0/T)_{298.15} = 17.55 \pm 0.07$ cal deg^{-1} $mole^{-1}$. An appendix summarizes the results of an investigation of the $Ag-Ag_2O$ electrode. A method was discovered for producing such half-cells which give stable, reproducible values for the emf of the cell $Ag_{(c)}|Ag_2O_{(c)}|\ |NaOH_{(aq)}|\ |HgO_{(c)}|Hg_{(l)}$. The behavior of unannealed, annealed, and macrocrystalline Ag_2O in this electrode was studied, and the results used to calculate $\Delta F^0_{298.15}$ for the cell reaction and for the formation of Ag_2O from its elements. These results are tabulated and compared with data from other sources. (auth)

26016 (AEC-tr-4755) IONOTROPIC GEL FILTERS WITH A CAPILLARY STRUCTURE. Heinrich Thiele and Klaus Hallich. Translated for Oak Ridge Gaseous Diffusion Plant from Kolloid Z., 163: No. 2, 116-22(1959). 29p. (Includes original, 8p.).

In the diffusion of opposed ions into polyelectrolytes, gels with uniform, round capillary channels lying parallel against each other are produced under certain conditions. The diameters, number and length of the capillaries can be varied by means of experimental conditions. Polymerization and condensation of synthetics results in stable membranes with isocapillaries. The membranes were investigated as filters as follows: microscopically, by determination of the water permeability, as well as gas permeability, and according to their pore distribution. (auth)

26017 (CEA-tr-R-1329) MOLYBDATES D'URANIUM-MOLURANITE ET IRIGINITE. (Molybdates of Uranium—Moluranite and Iriginite). G. Yu. (Iu.) Epshtein. Translated into French from Zapiski Vsesoyuz. Mineral. Obshchestva, 88: 564-70(1959). 17p.

The crystallographic, chemical, and physical properties of the two uranium molybdates—moluranite and iriginite—were determined. The empirical formula of moluranite is $UO_2 \cdot 3UO_3 \cdot 7MoO_3 \cdot 2OH_2O$. Calcination and x-ray analyses showed that the water is eliminated in the interval from 100 to 400°C and the principal residue is U_3O_8. Iriginite is also found in pulverized albitites and its empirical formula is $UO_3 \cdot 2MoO_3 \cdot 4H_2O$. Two other U minerals found in albitites are briefly described. (J.S.R.)

26018 (DEG-Inf-Ser-145) CHEMISTRY OF THE URANATES OF SOME GROUP II ELEMENTS. E. A. Ippolitova, I. P. Simanov, L. M. Kovba, G. P. Polunina, and I. A. Bereznikova. Translated by R. Hardbottle for U.K.A.E.A. Development and Engineering Group from Radiokhimiya, 1: 660-4(1959). 7p.

Thermal and x-ray diffraction analysis were used to investigate the composition of the uranates. The formation of several uranates was established: α-$CdUO_4$, β-$CdUO_4$, CdU_2O_7, Cd_3UO_6, ZnU_3O_{10}, α-$SrUO_4$, β-$SrUO_4$, CaU_2O_7, and BaU_2O_7. The structures of each are discussed. (P.C.H.)

26019 (NP-tr-520) PREPARATION OF THE CARBONYLS OF MOLYBDENUM AND TUNGSTEN. V. L. Volkov, E. P. Mikheev (Mikheyev), K. N. Anisimov, L. E. Eliseeva (Eliseyeva), and Z. P. Valueva (Valuyeva). Translated for Bureau of Mines from Zhur. Neorg. Khim., 3: 2433-6(1958). 4p.

The effects of the speed of the reaction, order of introducing the components, time, temperature, pressure, and the nature of the solvent on the mechanism of the process and the yields were investigated. Results show that synthesis of Mo carbonyl takes place within 2 to 3 hrs, and within 1 to 1.5 hrs for W carbonyl. Reaction temperature of 32 to 67°C insures a yield of 81 to 85% of the amount theoretical for W, and 85 to 96°C insures a yield of 83% for Mo. At 45°C the yield may reach 91%. (P.C.H.)

26020 (NP-tr-727) THE MELTING POINTS OF LITHIUM AND SODIUM UNDER PRESSURES UP TO 30,000 KG/CM^2. E. (Ye.) G. Ponyatovskii (Ponyatovskiy). Translated from Fiz. Metal. i Metalloved., 11: 476-7 (1961). 4p.

Pressure was developed by compressing a mixture of isopentane with n-pentane in a superhigh pressure multiplier. The melting point was determined by the thermal analysis method with photographic recording of the cooling and heating curves of the specimen. A table is given showing the dependence of the melting point of lithium, sodium, and potassium on pressure. (P.C.H.)

26021 REACTION OF BERYL WITH SODIUM FLUOROSILICATE USED IN EXTRACTING BERYLLIUM FROM THE MINERAL. K. R. Hyde, P. L. Robinson, M. J. Waterman, and J. M. Waters. Bull. Inst. Mining Met., 70: 605-13(July 1961).

Maximum extraction is attained with a sodium fluorosilicate : beryl molecular ratio of 3 : 1, at 725°C for 3 hours. Increasing time or temperature reduces the amount of extractable beryllium. The rate of reaction depended on the particle size of the beryl. Reaction mechanisms are discussed. (P.C.H.)

26022 SORPTION OF RADIOACTIVE ISOTOPES ON PRECIPITATES. V. SORPTION OF RADIORUTHENIUM ON MERCURY(II) SULFIDE. C. Konecny and D. M. Wagnerova (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Collection Czechoslov. Chem. Communs., 26: 1325-31(May 1961). (In German)

The sorption of nitrosyl ruthenium ions $RuNO^{3+}$ was followed on mercury(II) sulfide formed by the decomposition of sodium thiomercurate. The effects of hydrogen ion concentration, component ratios in the reaction mixture, the temperature, and the reaction time were investigated, and a probable clarification of the reaction mechanism is proposed. (tr-auth)

26023 THERMODYNAMIC FUNCTIONS OF Li^7F^{19}. J. Kučírek and D. Papoušek (Univ., Brno). Collection Czechoslov. Chem. Communs., 26: 1458-9(May 1961). (In German)

The values of free enthalpy, enthalpy, entropy, and heat content (calculated by the method of statistical thermodynamics for the state of an ideal gas at atmospheric pressure) are tabulated for temperatures from 273.16 to 3500°K. (J.S.R.)

26024 THERMAL STABILITY REGIONS OF DIFFERENT URANIUM OXIDES IN THE PRESENCE OF OXYGEN AND HYDROGEN. Pierre Margotin, Walter Stuckens, and Roger Durand (Laboratoire Central de Recherches, Levallois, France). Compt. rend., 252: 4005-6(June 19, 1961). (In French)

In order to understand the evolution of different phases, the thermal evolution of uranium oxides was studied by thermal analysis in an oxygen or hydrogen atmosphere. The results obtained, when added to x-ray diagrams, permit the thermal history to be reconstructed. Curves giving the ratio O/U as a function of the temperature show a rapid evolution during passage from one structure to another, whereas the transformations without phase change occur slowly. (J.S.R.)

26025 THE SUBLIMATION OF PLUTONIUM TETRAFLUORIDE. René Berger and Tino Gäumann (Univ. of California, Berkeley). Helv. Chim. Acta, 44: 1084-8(1961). (In German)

The vapor pressure of PuF_4 in the range of 1000 to 1300°K was measured. Experiments indicate that PuF_4 is the sublimed species up to the higher temperature limit. The possible disproportionation of PuF_4 at temperatures above this or the secondary disproportionation in the gaseous phase cannot be ruled out. (auth)

26026 RESULTS OF LOW TEMPERATURE RESEARCH. XXXVI. THE VAPOR PRESSURE DIFFERENCE OF $N^{14}N^{14}O$ AND $N^{15}N^{14}O$ BETWEEN THE MELTING AND BOILING POINTS. K. Clusius and K. Schleich (Universität, Zurich). Helv. Chim. Acta, 44: 1152-7(1961). (In German)

A vapor pressure comparison of the isotopic nitrogen oxides $N^{14}N^{14}O^{16}$, $N^{15}N^{14}O^{16}$, and $N^{14}N^{15}O^{16}$ is of special interest since both nitrogenous isotope isobars vary only in the moments of inertia and not in the mass. $N^{15}N^{14}O^{16}$, whose vapor pressure is larger by a factor of 1.00198 ± 0.00010 than normal N_2O, was measured between the melting and boiling points. The following values were determined for the thermal variables:

	N_2O	$N^{15}N^{14}O$	Δp or ΔT
Triple point pressure in mm Hg	658.95	660.18	1.23
Melting temperature, T_sK°	182.26	182.32	0.06^5_4
Boiling temperature, T_sK°	184.58	184.61	0.03^5_4

(tr-auth)

26027 INVESTIGATION INTO CONDITIONS OF TITANIUM–NIOBIUM CARBIDE CHLORINATION. G. A. Meyerson, A. N. Zelikman, L. V. Belyavaskaya, N. Ya. Tseytina, and G. F. Kirillova (Krasnoyarsk Inst. of Non-Ferrous Metals, USSR). Izvest. Vysshikh Ucheb. Zavedenii, Tsvetnaya Met., No. 5, 108-15(1960). (In Russian)

Chlorination kinetics of complex carbide was investigated using a horizontal quartz tube at 800, 600, and 400°C and 9 l/min chlorine feed. It was found that chlorination of compact carbide specimens was accompanied by the formation of an external graphite layer. At 400°C the effect of this layer on the chlorination rate was not noticeable (the process having a kinetic nature). At 600° and, in particular, at 800°C, some diffusion inhibition of the reaction was observed due to the graphite layer formed. The nature of the chlorination process becomes intermediate between kinetic and diffusion one, the former being prevalent. The dependence of the chlorination depth on the duration of the process was revealed and used to calculate the maximum possible duration of chlorination of various-size carbide particles at 400, 600, and 800°C. The operating chamber of the furnace represents a vertical graphite cylindrical tube with an expanding top pressed into a metallic housing with external heat insulation. A graphite grid is mounted in the chamber bottom. Carbide feed is performed with the aid of a screw feeder. Chlorination process can be conducted at levels of 280 to 420 mm due to the arrangement of discharge pipes at different heights. The furnace is heated with a digitate

quartz heater having two heating zones. Chlorides are collected with the use of a condensation system developed by Giredmet. During the chlorination process the graphite accumulates in the bed, concentrates on its surface, and is partially eliminated by the gas flow. To bind the carbon and eliminate it in a gaseous state, preliminary tests of carbide chlorination were made with a chlorine-oxygen mixture to form CO or CO_2. The rate of chlorine feed was 2.8 cm/sec for carbide of −100 μ-89%. After the onset of reaction at 200°C, the temperature in the bed raised spontaneously and the lower heater was automatically switched off. The top heater was switched off at 450°C. When operating with a chlorine−oxygen mixture, the latter was supplied to the furnace at 600°C. At the beginning of the experimental investigation carbide was supplied to the furnace periodically through a funnel and later on continuously by the screw feeder. Preheated carbide of the following composition was used: 52.40% Ti; 8.85% Nb; 4.67% Si; 0.24% Fe; 0.07% Ca; 12.17% C_{bound}; 11.10% C_{free}; 2.90% N; and 7.60% O. The experiments proved the possibility of continuous powder carbide chlorination in a fluidized bed with chlorine or a chlorine−oxygen mixture. The main advantage of the latter method is the elimination of C in the form of CO or CO_2. The process can be conducted in a fluidized bed on account of the reaction heat without an external heat supply even in a small-scale furnace (0.0177 m^2 floor surface). Fluidized-bed chlorination is characterized by a high output (300 kg/hr per m^2 of furnace floor), a high degree of utilization of raw materials (98−99%), and a fairly high purity of the products obtained. These values exceed considerably the efficiency of direct chlorination of ore concentrates in the form of briquets mixed with coal. (OTS)

26028 THERMODYNAMICS OF THE INTERACTION OF NIOBIUM AND TANTALUM WITH OXYGEN AND NITROGEN AT TEMPERATURES NEAR THE MELTING POINT. J. Paul Pemsler (Nuclear Metals, Inc., Concord, Mass.). J. Electrochem. Soc., 108: 744-50(Aug. 1961).

The concentration of nitrogen and oxygen present in niobium and tantalum in equilibrium with the pure gas was determined as a function of pressure at each of three temperatures near the melting point, and in the liquid phase at the melting point. A curious solubility inversion was noted in the tantalum−oxygen system where the oxygen concentration in equilibrium with a specified pressure of oxygen is lower at 2850 than at 2960°C. Data were used to calculate the partial molar and integral values of the free energy, enthalpy, and entropy of dissociation of solutions of nitrogen in niobium and tantalum, and partial molar free energy and enthalpy of dissociation of solutions of oxygen in niobium and tantalum. (auth)

26029 THE CRYSTAL STRUCTURE OF ACTINIUM METAL AND ACTINIUM HYDRIDE. J. D. Farr, A. L. Giorgi, M. G. Bowman, and R. K. Money (Los Alamos Scientific Lab., N. Mex.). J. Inorg. & Nuclear Chem., 18: 42-7(Mar. 1961). (In English)

The crystal structures of actinium metal and actinium hydride were determined by analyses of x-ray diffraction patterns. The results are summarized below:

Substance	Crystal structure	Unit cell dimensions (A)	Atomic radius (A)	Calculated density (g/cm^3)
Ac	f.c.c.	5.311±0.010	1.88	10.07
Actinium hydride	f.c.c.	5.670±0.006		8.35

(auth)

26030 INTERCONVERSION OF BORANES. II. DEUTERIUM ISOTOPE EFFECT IN THE DECOMPOSITION OF DIBORANE. R. E. Enrione and R. Schaeffer (Indiana Univ., Bloomington). J. Inorg. & Nuclear Chem., 18: 103-7(Mar. 1961). (In English)

The decomposition of B_2H_6 was shown to be five times faster than that of B_2D_6 by following the rate of hydrogen elimination. Factors affecting the concentration of one boron and three boron intermediates are discussed. The evidence is interpreted in terms of the reaction $B_3H_9 \rightarrow B_3H_7 + H_2$ as the rate controlling step of the decomposition. (auth)

26031 BINARY DODECABORIDES. S. La Placa, I. Binder, and B. Post (Polytechnic Inst. of Brooklyn). J. Inorg. & Nuclear Chem., 18: 113-17(Mar. 1961). (In English)

Cubic dodecaborides of Dy, Ho, Er, Tm, Lu, and Y, isomorphous with UB_{12} and ZrB_{12}, were prepared by the reaction of metal sesquioxides with excess amorphous boron at 1400−1500°C in a protective helium atmosphere. The boron atoms are linked in a rigid three dimensional network with metal atoms in large cubo-octahedral holes. The stability of the structure appears to be a sensitive function of the effective size of the metal atom; it could not be prepared when metal atoms larger than Dy or smaller than Zr were used. Coefficients of thermal expansion of HoB_{12} and of ErB_{12} were measured by x-ray-diffraction methods. (auth)

26032 PHASE RELATIONS IN THE SYSTEM LiF−PuF_3. C. J. Barton and R. A. Strehlow (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 18: 143-7(Mar. 1961). (In English)

26033 REACTIONS OF HYDROGEN FLUORIDE WITH METALS AND METALLOIDS. E. L. Muetterties and J. E. Castle (E. I. Du Pont de Nemours & Co., Wilmington, Del.). J. Inorg. & Nuclear Chem., 18: 148-53(Mar. 1961). (In English)

Closed-system reactions of liquid hydrogen fluoride with a number of metals, metalloids, and refractory materials were investigated. The reaction with metals proved to be a good route to pure fluorides. The closed system furnished two unique features: (1) the hydrogen generated in the fluorination maintained a strong reducing atmosphere that permitted isolation of otherwise difficultly obtainable fluorides of lower oxidation state, e.g., TiF_3 and NbF_3 and (2) the hydrogen is also believed to have contributed significantly to the reactivity of many of the transition metals by forming a metal hydride intermediate. (auth)

26034 THE URANIUM−OXYGEN SYSTEM: U_3O_8−UO_3. H. R. Hoekstra and S. Siegel (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 18: 154-65(Mar. 1961). (In English)

Preparative methods for five crystalline modifications and an amorphous form of uranium trioxide are described. Some properties of the UO_3 phases are discussed, including the density, crystal structure, heat of solution, thermal stability and infra-red spectrum. Data on the $UO_{2.9}$ phase are also given. (auth)

26035 THE LOW TEMPERATURE OXIDATION OF UO_2 AND U_4O_9. H. R. Hoekstra, A. Santoro, and S. Siegel (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 18: 166-78(Mar. 1961). (In English)

The low-temperature oxidation of UO_2 to U_3O_7 is shown to be a diffusion-controlled diphasic reaction. Two tetragonal phases of U_3O_7 have been identified: α-U_3O_7, with a = 5.46 A, c = 5.40 A and β-U_3O_7 with a = 5.38 A, c = 5.55

A. Annealing experiments with β-U_3O_7 show the existence of a third tetragonal phase with a composition approximately $UO_{2.3}$, which is stable to 500°C. Its parameters are a = 5.41 A, c = 5.49 A. The oxidation of U_4O_9 is also controlled by diffusion of oxygen through a second phase, $UO_{2.3}$ which is in turn converted to β-U_3O_7. Evidence is given to show that the oxidized surface layer which forms on UO_2 at 25°C is amorphous UO_3. (auth)

26036 ELECTROCHEMICAL STUDIES OF PLUTONIUM IONS IN PERCHLORIC ACID SOLUTION. Donald Cohen (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 18: 207-10(Mar. 1961). (In English)

A potentiostat was used to obtain current-voltage curves for the oxidation-reduction reactions of plutonium ions and to prepare the four valence states of plutonium in perchloric acid solutions. (auth)

26037 THE ABSORPTION SPECTRA OF PLUTONIUM IONS IN PERCHLORIC ACID SOLUTIONS. Donald Cohen (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 18: 211-18(Mar. 1961). (In English)

The absorption spectra of the four ions of plutonium were measured in the region between 2000 and 12,500 A in perchloric acid solutions. (auth)

26038 PHASE EQUILIBRIA IN THE SYSTEM LiF–YF_3. R. E. Thoma, C. F. Weaver, H. A. Friedman, H. Insley, L. A. Harris, and H. A. Yakel, Jr. (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 65: 1096-9(July 1961).

The phase equilibrium diagram of the condensed system LiF–YF_3 is presented. Data were obtained from thermal analysis of heating and cooling curves and by identifying the phases present in small samples which were quenched after equilibration at high temperatures. Within the system two invariant points occur, the eutectic at 19 mole % YF_3 and 695°, and the peritectic at 49 mole % YF_3 and 819°. The single intermediate compound, $LiF \cdot YF_3$, is formed. It melts incongruently to YF_3 and liquid at 819°, and is tetragonal, $a_0 = 5.26 \pm 0.03$ Å, and $c_0 = 10.94 \pm 0.03$ Å, space group $I4_1/a$. The compound $LiF \cdot YF_3$ is colorless, uniaxial (+), with refractive indices $N_\omega = 1.454$, $N_\epsilon = 1.472$. No solid solutions are formed among the equilibrium solids in the system LiF–YF_3. The melting point of YF_3, 1148°, previously determined, was corroborated. A solid state transition in YF_3 was shown to occur at 1052°. (auth)

26039 ANION EXCHANGE AND NON-AQUEOUS STUDIES OF THE ANIONIC NITRATO COMPLEXES OF THE HEXAVALENT ACTINIDES. J. L. Ryan (General Electric Co., Richland, Wash.). J. Phys. Chem., 65: 1099-1107 (July 1961).

Spectrophotometric studies in aqueous and non-aqueous systems with miscellaneous supporting data were used to identify the species of the hexavalent actinides which are absorbed by anion exchange resins from nitrate solutions. The previously unreported tetranitrato complexes, $MO_2(NO_3)_4^{2+}$, were identified in solid compounds, in nitromethane solutions, and in anion-exchange resins. The anion exchange resins were found to absorp predominantly the tetranitrato ions along with a lesser amount of the trinitrato ions $MO_2(NO_3)_3^-$. The relative amounts of these two species in the resin phase were found to be dependent of resin phase properties and not detectably dependent on solution phase properties. The formation constant for the reaction $UO_2(NO_3)_3^- + NO_3^- \rightleftharpoons UO_2(NO_3)_4^{2-}$ in nitromethane was found to be 4.7 ± 0.2. (auth)

26040 ADSORPTION OF NITROGEN AND ARGON ON MINERALOGICAL GRAPHITE AND DIAMOND AT 77 AND 90°K. Juan De Dios Lopez-Gonzalez, Frank G. Carpenter, and Victor R. Deitz (National Bureau of Standards, Washington, D. C.). J. Phys. Chem., 65: 1112-19(July 1961).

Adsorption isotherms were measured in the relative pressure range from 10^{-3} to about 0.5. The samples were outgassed at 450° for 18 hours before each of a series of measurements. Upon the first exposure of the outgassed solid to the gas, a delay occurred in the adsorption. An initial period of low rate of adsorption was followed by a period of much higher rate and finally by attainment of a steady state. The isotherms at the two temperatures based on the steady-state values crossed in the neighborhood of unit coverage (defined by v_m from point B) for both gases and both solids. The isotherms on graphite showed a definite step at relative pressures between 10^{-3} and 10^{-4}. The heats and entropies of adsorption at constant spreading pressure were determined and graphs are presented as a function of coverage. Broad maxima in the heats were observed in the neighborhood of $\theta = 0.1$ to 0.01; the entropy showed minima at $\theta = 1.0$ and increased steadily as the coverage decreased. The systems studied are considered to be examples of interaction with low energy surfaces for which the entropy changes are appreciable, making a significant contribution to the free energy change of the adsorption process. (auth)

26041 THE DETERMINATION OF DENSITY DISTRIBUTIONS AND DENSITY GRADIENTS IN BINARY SOLUTIONS AT EQUILIBRIUM IN THE ULTRACENTRIFUGE. James B. Ifft, Donald H. Voet, and Jerome Vinograd (California Inst. of Tech., Pasadena). J. Phys. Chem., 65: 1138-45(July 1961).

The calculation of density gradients and density distributions in binary solutions at sedimentation equilibrium in an ultracentrifuge is presented. The differential equation describing sedimentation is $\beta(\rho)d\rho = \omega^2 r\, dr$ where β is a function of the temperature and the activity, molecular weight, and partial specific volume of the solute at a density ρ. Values of β were calculated from published data for density and activity over the entire concentration range for CsCl, KBr, RbBr, RbCl, LiBr, and sucrose at 25.0°. For each binary system $\beta(\rho)$ was expressed as a cubic polynomial in ρ. The integral form of the above equation was then solved for the integration constants using a digital computer for the first four salts mentioned. The integration constant is the radial distance at which the initial density of the solution occurs. This is the isoconcentration position. Experimental confirmation of the density gradient and of a density distribution for CsCl are presented. (auth)

26042 TRIFLUOROBOROXINE: PREPARATION, INFRARED SPECTRUM AND STRUCTURE. H. D. Fisher, W. J. Lehmann, and I. Shapiro (Hughes Tool Co., Culver City, Calif.). J. Phys. Chem., 65: 1166-8(July 1961).

The reaction of boron trifluoride with various oxygen-containing compounds leads to the formation of a compound with the empirical formula of $(BOF)_x$. On the basis of spectroscopic work, the ring structure was confirmed. (auth)

26043 FLUORINE BOMB CALORIMETRY. I. THE HEAT OF FORMATION OF ZIRCONIUM TETRAFLUORIDE. Elliott Greenberg, Jack L. Settle, Harold M. Feder, and Ward N. Hubbard (Argonne National Lab., Ill.). J. Phys. Chem., 65: 1168-72(July 1961).

The heat of formation of zirconium tetrafluoride was measured by direct combination of the elements in a bomb calorimeter. $\Delta H f°$ at 25° was found to be -456.8 ± 0.2 kcal $mole^{-1}$. The experimental techniques are presented in detail. (auth)

26044 ELECTRON IMPACT SPECTROSCOPY OF ETHYLENE SULFIDE AND ETHYLENIMINE. Emilio

Gallegos and Robert W. Kiser (Kansas State Univ., Manhattan). J. Phys. Chem., 65: 1177-82(July 1961).

The appearance potentials and relative abundances determined with a time-of-flight mass spectrometer are reported for the principal positive ions in the mass spectra of ethylene sulfide and ethylenimine. The probable ionization and dissociation processes consistent with the computed energetics are given. Molecular ionization potentials are calculated using the equivalent orbital method and are compared to the observed ionization potentials of 9.94 ± 0.15 ev for ethylenimine and 8.87 ± 0.15 ev for ethylene sulfide. A comparison of the fragmentation patterns and dissociation processes is given for ethylene oxide, ethylene sulfide, and ethylenimine. (auth)

26045 THE SYSTEM POTASSIUM BROMIDE–CADMIUM CHLORIDE. I. SURFACE TENSION. R. B. Ellis, J. E. Smith, W. S. Wilcox, and E. H. Crook (Univ. of Pennsylvania, Philadelphia). J. Phys. Chem., 65: 1186-8 (July 1961).

Studies of the surface tension of the fused-salt system $CdCl_2$–KBr at temperatures from near the melting point up to 900° show that mixtures of these salts are decidedly non-ideal. Deviations from ideality reach maxima at 40 to 60 mole % KBr in the stated temperature range. Also there is a pronounced maximum in the surface heat of mixing at about 60 mole % KBr, which may be taken as an indication of the formation of complex ions. Observations of Raman spectra of melts at 67 and 40 mole % KBr show evidence of complex ion formation. The observed Raman bands may be attributed to the species $CdCl_4^{2-}$ and $CdBr_4^{2-}$. (auth)

26046 SUB-SOLIDUS EQUILIBRIA IN THE SYSTEM Nb_2O_5–Ta_2O_5. F. Holtzberg and A. Reisman (International Business Machines, Yorktown Heights, N. Y.). J. Phys. Chem., 65: 1192-6(July 1961).

Phase equilibria in the system Nb_2O_5–Ta_2O_5 were reinvestigated using thermal analysis and x-ray techniques. A compound formed above 1450°, having the composition $2Nb_2O_5.Ta_2O_5$, was indexed on the basis of a body centered cubic unit cell with a_0 = 15.76 Å. Below 1450°, the compound decomposes sluggishly to form a two phase region extending from 25 to 51 mole % Ta_2O_5. An explanation is offered to account for the apparent reversibility of Nb_2O_5 phases previously reported. (auth)

26047 EFFECT OF CHLORIDE ON THE KINETICS OF ELECTROOXIDATION OF CHROMIUM(II) IN ACIDIC PERCHLORATE MEDIUM. David A. Aikens and James W. Ross, Jr. (Massachusetts Inst. of Tech., Cambridge). J. Phys. Chem., 65: 1213-16(July 1961).

The effect of chloride on the kinetics of the electrooxidation of chromium(II) in acidic 1 M sodium perchlorate solution was studied by the potentiostatic technique at the hanging mercury drop electrode. A convenient method of in situ generation of chromium(II) for electrode kinetic studies was devised by a simple modification of the direct potentiostatic technique. At constant applied potential, the oxidation of chromium(II) is enhanced by chloride, the reaction following two parallel paths. The first is independent of chloride, yielding hexaaquachromium(III), and the second is first order in chloride at chloride concentrations up to 50 millimolar, yielding chloropentaaquachromium(III). The ability of the halides to enhance the reaction increases from fluoride to chloride to iodide, indicating that tendency of the halides toward specific adsorption at the electrode surface determines their relative efficiencies in enhancing the reaction. (auth).

26048 THE FLUORIDE COMPLEXES OF SILVER AND STANNOUS IONS IN AQUEOUS SOLUTION. Robert E. Connick and Armine D. Paul (Univ. of California, Berkeley). J. Phys. Chem., 65: 1216-20(July 1961).

Previous work on the fluoride complexing of argentous ion was repeated at an ionic strength of 0.5 M and as a function of temperature to yield values for the equilibrium constant, heat, and entropy of formation of the first fluoride complex. A value for the first fluoride complex of stannous ion was measured at 25° using both an emf method and a spectrophotometric method. The former made use of the tin amalgam–stannous ion couple while the latter depended on uranyl ion as a spectrophotometric indicator for fluoride ion. Although the results of the two methods are in substantial agreement with each other, the values of the equilibrium quotient as a function of stannous ion and hydrogen ion concentrations are not constant. No explanation was found for the discrepancy. (auth)

26049 THE ELECTRICAL CONDUCTIVITY OF SOLUTIONS OF METALS IN THEIR MOLTEN HALIDES. II. SODIUM–SODIUM IODIDE, POTASSIUM–POTASSIUM IODIDE, AND POTASSIUM–POTASSIUM FLUORIDE. H. R. Bronstein and M. A. Bredig (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 65: 1220-4(July 1961).

The study of the alkali metal–halide systems was extended to NaI–Na, KI–K, and KF–K. The results confirm the striking difference in the behavior of the sodium and potassium solutions at the particular test temperatures. The equivalent conductance of the dissolved metal rises monotonically toward that of the pure metal in the case of potassium, but goes through a deep minimum in the case of sodium. In the latter case, electrons are thought to be trapped in the covalent bonds of Na_2 molecules. The enhancing effect of the polarizability of the anion upon the equivalent conductance of the metal in dilute solutions, Λ_M^∞, is again demonstrated: at 900°, Λ_M^∞ in KF–K is 800, but in KI–K is 8100 $ohm^{-1}\ cm^2\ equiv^{-1}$. The difference in the power of the cations Na^+ and K^+ to polarize the large I^- anion, and thus to lower the potential barrier for electron movement, is seen reflected in the difference of Λ_M^∞, 16,000 $ohm^{-1}\ cm^2\ equiv^{-1}$ for NaI–Na as against 8100 for KI–K. (auth)

26050 CHLORIDE COMPLEXES OF IRON(III) IONS AND THE KINETICS OF THE CHLORIDE-CATALYZED EXCHANGE REACTION BETWEEN IRON(II) AND IRON(III) IN LIGHT AND HEAVY WATER. N. Sutin, J. K. Rowley, and R. W. Dodson (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 65: 1248-52(July 1961). (BNL-5393)

The association of iron(III) ions with chloride ions and the kinetics of the electron exchange between iron(II) ions and the chloride complexes of iron(III) ions were studied in H_2O and D_2O. From spectrophotometric measurements the equilibrium constant, K_1, for the reaction $Fe^{3+} + Cl^- \rightleftharpoons FeCl^{2+}$ is 2.0 times larger in D_2O than in H_2O. The value of $K_1(H_2O)$ is 4.4 and $\Delta H_1(H_2O)$ is 5.0 kcal $mole^{-1}$ at 25° and an ionic strength of 0.50. A small difference in the temperature coefficient of K_1 is found in the two solvents. The exchange reaction between $FeCl^{2+}$ and Fe^{3+} proceeds 2.5 times more rapidly in H_2O than in D_2O. The kinetic isotope effect is nearly the same as that found in the Fe^{3+} to Fe^{3+} and Fe^{3+} to $FeOH^{2+}$ exchanges. The isotope effects are discussed in terms of an electrostatic model. (auth)

26051 KINETICS OF THE REACTION BETWEEN Pu(VI) AND Sn(II) IN CHLORIDE-PERCHLORATE SOLUTION. S. W. Rabideau and B. J. Masters (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 65: 1256-61 (July 1961).

A study was made of the kinetics of the reaction, Pu(VI) + Sn(II) → Pu(IV) + Sn(IV). In mixed chloride–perchlorate

media, the rate of Pu(VI) reduction is first-order dependent upon the concentration of each reactant, strongly dependent upon the chloride ion concentration, and independent of the hydrogen ion concentration. These observations are consistent with a parallel path mechanism in which the reaction proceeds primarily through activated complexes having the formulas $(PuO_2 \cdot Sn \cdot Cl_3)^+$ and $(PuO_2 \cdot Sn \cdot Cl_4)^0$. Thermodynamic quantities for the activation processes were obtained for these two reaction paths, and the correlation between charge and entropy was found to apply to these activated complexes of charge +1 and zero. The experimental observation that the reduction of Pu(VI) by Sn(II) occurs much more rapidly than does the reduction of Pu(V) by Sn(II) was interpreted as evidence that the Pu(VI)–Sn(II) reaction proceeds through a single step mechanism which involves the transfer of two equivalents of charge. (auth)

26052 ADSORPTION OF CONGO RED BY HYDROUS THORIUM OXIDE. Rameshwar Prasad and Arun K. Dey (Univ. of Allahabad, India). J. Phys. Chem., 65: 1272-3 (July 1961).

Results show that the adsorptive capacities of samples of hydrous thorium oxide decrease with increasing temperature. The 4 samples were precipitated as follows: A with 10% deficient NaOH, B with equivalent NaOH, C with 5% excess NaOH, and D with 10% excess NaOH. The order of adsorption is A > B > D > C. The solutions at equilibrium become very faint in color and the adsorbents assume an orange color due to the association of the dye. (P.C.H.)

26053 ELECTRIC MOMENTS OF SOME ADDITION COMPOUNDS OF ZINC CHLORIDE WITH ORGANIC BASES. M. Judith Schmelz, M. Ann Gertrude Hill, and Columba Curran (Univ. of Notre Dame, Ind.). J. Phys. Chem., 65: 1273-4(July 1961).

Dioxane was used as solvent for the complexes of zinc chloride with pyridines and the picolines for dielectric constant measurements, and benzene for dichlorobis-(triethylphosphine)-zinc. The moments of zinc chloride complexes are in the order: γ-picoline > β-picoline > pyridine > α-picoline. These and other moments obtained reveal an anomaly in the relative polarities of zinc and boron complexes. (P.C.H.)

26054 K ABSORPTION SPECTRA OF ZIRCONIUM, ITS OXIDE, AND ITS OXYCHLORIDE. Alexis Ganson (Laboratoire de Chimie Physique de la Faculte des Sciences, Paris). J. phys. radium, 22: 298-302(May 1961). (In French)

Results of an investigation on x-ray absorption spectra of zirconium, hydrated and anhydrous ZrO_2, and $ZrOCl_2$ as well as of solutions of $ZrOCl_2$ are given for varying absorbing screen thickness (or concentrations of the solutions). The spectra were obtained with a Cauchois spectrograph with a bent mica crystal by transmission. The K absorption edge of metallic Zr was shown to fall in two steps. An explanation is proposed. (auth)

26055 CHEMICAL COMPOSITION AND CATALYTIC PROPERTIES OF ZIRCONIUM SILICATE CATALYSTS. A. D. Makarov, G. K. Boreskov, and V. A. Dzisko (Karpov Inst. of Physics and Chemistry, USSR). Kinetika i Kataliz, 2: 84-93(Jan.-Feb. 1961). (In Russian)

Chemistry, catalytic activity, and selectivity of zirconium silicate catalysts are discussed in relation to the preparation of divinyl from ethyl alcohol mixtures and acetaldehyde, disintegration of ethyl and isopropyl alcohols, and crotonization of acetaldehyde. A chemical compound with composition close to equimolar, containing 3% structural water, and possessing strong acidity is an active component of zirconium silicate catalysts. In comparison to pure ZrO_2 and SiO_2 the chemical compound possesses higher activity and selectivity in divinyl formation. The increased catalytic ability is caused by a proton group on the surface of the compound. (tr-auth)

26056 CATALYTIC PROPERTIES OF YTTRIUM OXIDE. CONVERSION OF ALCOHOLS AND HYDROCARBONS. A. A. Tolstopyatova, I. R. Konenko, and A. A. Balandin (Zelinskii Inst. of Organic Chemistry, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 135-43(Jan.-Feb. 1961). (In Russian)

Catalytic properties of hydrated and water-free yttrium oxides in dehydrogenating and dehydrating ethyl, isopropyl, n-butyl, and n-propyl alcohols and dehydrogenating methyl alcohol and tetralin were studied. The activation energies and magnitudes of pre-exponential multipliers in these reactions were determined. It is shown that with catalyst surface carbonization the ratio of the reaction rates for dehydration and dehydrogenation is increased. The number of unhindered alkyl substitutes effects the magnitudes of activation energies and k_0 for dehydrogenation and dehydration of alcohols while their length does not exert any influence. (tr-auth)

26057 SPECIFIC HEATS OF DELTA-PHASE Zr–H AND Zr–D. Walter J. Tomasch (Atomics International, Canoga Park, Calif.). Phys. Rev., 123: 510-14(July 15, 1961).

The specific heats of fcc $ZrH_{1.58}$ and $ZrD_{1.58}$ have been measured in the temperature interval 30–500°C. The data are interpreted in terms of a harmonic oscillator model for the hydrogen and deuterium specific heat contributions. This model is in accord with recent inelastic neutron scattering studies and predicts an isotopic depression of the deuteride Einstein temperature by a factor of $1/\sqrt{2}$ relative to the hydride value. Over the interval 30–200°C, the data and model are quantitatively consistent. At higher temperatures, the deuteride specific heat is somewhat smaller than anticipated. Quantities of noncubic γ-phase material are known to be present in the samples used, particularly in the deuteride, and this is thought to be a likely cause for the deviations. The hydride Einstein temperature calculated from the difference between deuteride and hydride specific heats at 150°C is 1500 ± 300°K, as compared with the inelastic neutron scattering value of 1500 ± 60°K. (auth)

26058 TEMPERATURE VARIATION OF IONIC MOBILITIES IN HYDROGEN. Lorne M. Chanin (Honeywell Research Center, Hopkins, Minn.). Phys. Rev., 123: 526-9 (July 15, 1961).

Measurements have been made of the temperature variation of the mobilities of positive ions in hydrogen over the range 77°–300°K. The zero-field mobility values are μ_0 = 12.3 cm^2/v sec (300°K), 13.3 (195°K), and 13.0 (77°K). The present results at 300°K are in agreement with the data of Lauer, Bradbury, and Mitchell at low E/p_0, and at high E/p_0 agree with Rose's measurements. Only a single ion species was observed in the present studies. Reasons are given which support the belief that the ion observed in these measurements was H_3^+. (auth)

26059 EVIDENCE FOR THE DOUBLE F MODEL OF THE M CENTER. Bruce J. Faraday, Herbert Rabin, and W. Dale Compton (U. S. Naval Research Lab., Washington, D. C.). Phys. Rev. Letters, 7: 57-9(July 15, 1961).

Evidence is presented that the M center is produced by the association of two F centers (i.e., 2F → M). The x-irradiation production of M and F centers is studied at liquid N_2 and He temperatures in KCl and KBr, and the M and F center equilibria are studied at room temperature in NaCl and LiF. It is found that the M center concentration

varies quadratically with the F center concentration. It is shown that the quadratic variation implies $2F \rightarrow M$, in the temperature range studied. (T.F.H.)

26060 AN INTRODUCTION TO TRANSITION-METAL CHEMISTRY: LIGAND-FIELD THEORY. Leslie E. Orgel. London, Methuen & Co., Ltd. and New York, John Wiley & Sons, Inc., 1960. 180p.

A short, non-mathematical account is given of the ligand-field theory. Such topics as orbitals, energies, ions with several electrons, stereochemistry, ionic radii and stability of transition metal compounds, energy level diagrams and spectra, reaction rates and mechanisms, covalent and ionic bonding, low and high valencies, and complexes formed by unsaturated hydrocarbons are discussed. (N.W.R.)

26061 VAPORIZATION OF OXIDES. R. J. Ackermann and R. J. Thorn (Argonne National Lab., Ill.). p.39-88 of "Progress in Ceramic Science. Volume I." J. E. Burke, ed. New York, Pergamon Press, 1961. 238p.

Published results are discussed and examined in order that reliable free energies of vaporization and formation of gaseous oxides can be tabulated, and the importance of the vaporization process and the need for accurate data in ceramic and chemical studies are briefly illustrated. An attempt is made to separate the reliable observations from the tenuous ones. Discussion is also given on the oxides of the groups IA, IIA, IIIA, IVA, VA, VIA, IIIB, and IVB along with the oxides of separate elements including Li, Be, Mg, Ca, Sr, Ba, B, Al, Y, La, Si, Ti, Zr, Hf, Th, V, Ta, Mo, W, and U. 130 references are given. (P.C.H.)

Radiation Chemistry and Radiochemistry

26062 (ASD-TR-61-7-840) NUCLEAR HYDRAZINE PROGRAM. Final Technical Engineering Report, March 22, 1960–March 22, 1961. J. H. Cusack, R. I. Miller, and H. P. Yockey (Aerojet-General Nucleonics, San Ramon, Calif.). July 1961. Contract AF 33(600)-40878. 233p.

A new process is presented for producing hydrazine from liquid ammonia utilizing energy from irradiation of suspended fissile materials. Fully enriched uranium in the form of micron size uranium dioxide particles was suspended in liquid ammonia and exposed to a reactor neutron flux. The resulting hydrazine yield indicated this process is within the range of economic interest, and preliminary production plant design and estimated capital and operating costs are presented. These preliminary estimates indicate that a 175-Mw(t) reactor would produce 52.5 million pounds of anhydrous hydrazine per year at an amortized production cost of about 25 cents per pound. Chemical and energy deposition analysis methods were developed and are described. Fuel solubility and hazards analysis are discussed. Experimental equipment designs are presented together with detailed operating experience. (D.L.C.)

26063 (CEA-1785) MESURE DU RAPPORT C/H AU MOYEN DES NEUTRONS. (Measurement of the C/H Ratio Using Neutrons). Pierre Martinelli and Huaringa Ricci (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1960. 16p.

Presented at the Conference on the Application of Radioisotopes in Physical Sciences and Industry, Copenhagen, June 1960.

A probe made up of a Ra(α,n)Be neutron source and a proportional counter filled with boron trifluoride was used to measure the C/H ratio in hydrocarbons. The intensity of the thermal neutron flux in the neighborhood of the detector increases with the concentration of the hydrocarbon hydrogen surrounding it. By measuring the density it is possible to deduce the C/H ratio. Thus it is possible to evaluate the C/H ratio with a precision equal to that given by the β-ray transmission method. The errors arising from the chemical nature of the hydrocarbon can be reduced to a minimum. The method has the advantage of allowing the measurement of the C/H ratio of hydrocarbons contained in recipients or thick steel tubing by means of an independent portable apparatus. (auth)

26064 (NAS-NS-3038) THE RADIOCHEMISTRY OF TELLURIUM. G. W. Leddicotte (Oak Ridge National Lab.). July 1961. 46p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

The radiochemistry of tellurium is discussed. A review of nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution and counting techniques, and a collection of radiochemical procedures for the element as found in the literature are included. (M.C.G.)

26065 (TID-13284) RADIOLYTIC AND PHOTOCHEMICAL DECOMPOSITION AND EXCHANGE IN LIQUID AND GASEOUS CCl_3Br. Austin H. Young and John E. Willard (Wisconsin. Univ., Madison). [1961]. 21p.

Studies are reported on the radiolysis of liquid and gaseous CCl_3Br, the photolysis of gaseous CCl_3Br, and the radiation-induced exchange of bromine between Br_2 and CCl_3Br in the liquid and gaseous phases. Co^{60} gamma rays and 2537 Å light were the activating radiations. Typical product yields are given in units of molecules/100 ev. The apparent activation energies for the formation of the products are about 3 kcal/mole, which is lower than required for thermal radical and atom abstraction reactions in this system. This may result from a small contribution from thermal processes superimposed on a major contribution from temperature insensitive reactions of vibrationally excited species or ions. The reaction cross sections for these hot processes must be significantly lower than the collision cross sections since the yields are reduced by 1 mole % added Br_2. The G values for the exchange caused by γ rays in the gas and in the liquid at 108°C are both of the order of 700 atoms/100 ev absorbed while that in the liquid at 20°C is about 150. These values indicate chain reactions with an over-all activation energy which appears to be too low to be explained on the basis of the known thermal chemistry of the system, and so may include a contribution from ion molecule reactions. G (exchange) is sensitive to some unknown variable but is not significantly affected by 2 mole % O_2 in the presence of 1 mole % Br_2. (auth)

26066 (TID-13303) RADIATION EFFECTS IN BIOCHEMISTRY AND ORGANIC CHEMISTRY. Technical Progress Report, October 15, 1960 to October 14, 1961. (Colorado. Univ., Boulder). Contract AT(11-1)-690. 71p.

Progress is reported for the following projects: radiation stability of various compounds, including amino acids, peptides and their amino acid residues, nucleic acid components, and simple sugars; radiation decarboxylation of amino acids, carboxylic acids and corresponding carboxylate salts, metal salts, and amino acid chelates; and nature of the irradiated solid state. (D.L.C.)

26067 (TID-13352) STUDIES IN RADIATION CHEMISTRY AND CHEMICAL KINETICS. Technical Progress Re-

port, June 1, 1960 through May 31, 1961. (Illinois. Univ., Urbana). Contract AT(11-1)-691. 16p.

Diffusion Kinetics. Calculations were carried out on some mechanisms in the radiolysis of aerated solutions of Fe^{3+}, Cu^{2+}, and HCOOH in 0.01 N H_2SO_4 and of deaerated aqueous solutions. Calculations were also made of the primary yields of D_2O as compared to those of H_2O. Interaction of Low-Energy Electrons with Molecules. Testing and modifications of an electron spectrometer are reported. Kinetics and Mechanisms of Some Gas-Phase Reactions. Decomposition products of equimolar $n\text{-}C_4H_{10}$ + $n\text{-}C_4D_{10}$ mixtures at 450 to 550°C were found to contain no CH_4 or C_2H_6 formed by a molecular split process. (D.L.C.)

26068 (AEC-tr-4482(p.335-54)) POLYMER REACTION BY GAMMA-RAYS. I. Sakurada, S. Okamura, and H. Inagaki.

Measurement of the G value for the benzene–carbon tetrachloride system showed the sensitization of the decomposition of benzene by mixing with it a small amount of carbon tetrachloride. A rate equation was derived for the radical formation in two-component systems. The rate and degree of polymerization of styrene in carbon tetrachloride solution were determined. Studies were made of the decomposition of polymethyl methacrylate in solution in relation to the G values of the solvents. The change of strength, degree of elongation, and change of relative viscosity in H_2SO_4 for monofilaments of nylon irradiated at 10^4 to 10^8 r, both in air and nitrogen. The radioinduced decomposition of polyvinyl alcohol was investigated. The effects of the presence of air on the gelation of silicone resins of two different molecular weights were determined. (M.C.G.)

26069 (AEC-tr-4482(p.355-71)) POLYMERIZATION OF ACRYLONITRILE IN AQUEOUS SOLUTION BY GAMMA-RAY. T. Tsuda and K. Sando.

Gamma irradiation polymerization in aqueous acrylonitrile solution was investigated using Co^{60}. The molecular weights of the resulting products depended on the proportion of the fraction of the reaction finished. The presence of oxygen made the induction period very long but did not affect the rate of polymerization. From measurements of the rate of polymerization at different temperatures between 20 and 40°C, 4.5 kcal/mole was obtained for the value of the apparent energy of activation. This led to the conclusion that the energy of activation for the production of free radicals in the radiation polymerization is close to zero. The molecular weight of the polymers produced increased with increasing temperature. Data suggested a chain transfer mechanism in the polymerization reaction. The rate of the polymerization was only slightly increased in the lower pH region, but it was very much decreased at higher pH. The rate of polymerization in organic solvents was small compared with that in an aqueous solution. (M.C.G.)

26070 (AEC-tr-4482(p.372-83)) GRAFT VINYL COPOLYMERS OF POLYETHYLENE AND NYLON. Y. Shinohara, M. Kashiwagi, and E. Mukoyama.

The irradiation of nylon polyethylene in the vapor phase of different vinyl compounds was carried out to study graft polymerization. The viscoelastic properties of the nylon and polyethylene graft polymers of methylacrylate, acrylic acid, and acrylonitrile were determined. Applications of graft polymers are discussed. (M.C.G.)

26071 (AEC-tr-4482(p.384-98)) EFFECTS OF RADIATION OF POLYVINYL ALCOHOL. K. Shinohara, T. Takamatsu, and N. Tamura, et al.

The effects of gamma radiation on polyvinyl alcohol are discussed. The radiation source was divided into 20 cylinders placed in a circle around the irradiation capsule. The radiation effects in vacuum and in air were compared. The nuclear magnetic resonance in irradiated polyvinyl alcohol films was measured at various humidities. Gel formed by irradiation could not be transformed into sol by heat. It was therefore assumed that the cross-linking in this case is due to the irreversible formation of chemical bonds. The limiting velocity just before gelation was measured. If solid polyvinyl alcohol was irradiated in its swollen state, the absorbed water was mainly in the amorphous part and formed a concentrated solution. If gelation in swollen polyvinyl alcohol occurred in the amorphous part, the effects of irradiation depended on the degree of crystallization which depended on the heat treatment of the sample. (M.C.G.)

26072 (AEC-tr-4482(p.475-93)) APPLICATION OF ABSORPTION OF SOFT GAMMA-RAY AND BETA-RAY-EXCITED X-RAYS TO CHEMISTRY. T. Nozaki.

The absorption coefficient of gamma rays and beta-excited x rays is strongly dependent on the atomic number. Using this characteristic, an attempt was made to measure the velocity of chemical reactions and to perform a chemical analysis. The isotopes Hg^{203}, Tl^{204}, and Pb^{210} were used as sources. Absorption coefficients for various materials were obtained. A quantitative analysis of solder was carried out as an example of the two-component system. A formula was derived for the quantitative analysis of a particular element with a high atomic number in a multi-component system. Using this formula, the amount of barium in barium glass and the amount of lead in lead glass were determined. It is shown that the absorption of the photon can be applied to measurements of chemical reaction velocity in a non-uniform system with material of high atomic number. Radiation hazards involved in these applications are discussed. (M.C.G.)

26073 THERMAL ANNEALING OF RECOIL ATOMS IN NEUTRON IRRADIATION OF INORGANIC PHOSPHORUS COMPOUNDS. Hiroshi Baba, Kenji Yoshihara, Hiroshi Amano, Kichizo Tanaka, and Nagao Shibata (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 590-1(Apr. 1961). (In English)

The recoil effects in neutron-irradiated sodium phosphate crystals are studied in terms that the distribution of recoil atoms is changed by thermal annealing. Results show that on the isothermal annealing of irradiated sodium orthophosphate crystal (anhydrous, tribasic) at 167°C the orthophosphate fraction increased remarkably, whereas the pyrophosphate fraction decreased appreciably, but the phosphite fraction slightly decreased. In the case of the phosphate crystal (anhydrous, dibasic) the orthophosphate fraction first increased and then decreased, whereas the pyrophosphate fraction first decreased and then increased. The polyphosphate fraction decreased monotonously and the phosphite decreased slightly. The annealing effects of sodium pyrophosphate show that the pyrophosphate fraction remarkably increased and the polyphosphate fraction decreased. The orthophosphate and phosphate fractions only slightly decreased. (N.W.R.)

26074 NEUTRON IRRADIATION OF THE SYSTEM ARSENIC TRICHLORIDE–BENZENE. J. Cífka and Z. Melichar (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague and Faculty for Technical Physics and Nuclear Physics, Prague). Collection Czechoslov. Chem. Communs., 26: 1403-13(May 1961). (In German)

The distribution of As^{76} between various forms (inorganic arsenic compounds and derivatives of phenyl and diphenyl amines) was investigated in benzene solutions irradiated with reactor neutrons. The yield of As^{76} in the form of phenylarsine decreases rapidly with decreasing arsenic

trichloride concentration. The effect of γ radiation on the system studied was also followed. (tr-auth)

26075 ON THE VARIATION AT LOW TEMPERATURE OF THE HYPERFINE STRUCTURE SIGNALS IN ELECTRON PARAMAGNETIC RESONANCE OF GLYCOCOL IRRADIATED BY GAMMA RAYS. R. Servant. Compt. rend. colloq. ampère, 9e colloq., Pise, 1960, p.301-2. (In French)

Polycrystalline glycocol was irradiated with γ rays and the resonance signal obtained at 10000 MHz exhibits the triplet already reported. Two weak lateral components were also observed. The irradiated glycocol was then cooled to the temperature of liquid nitrogen. During the cooling the hyperfine structure is modified and passes to a structure with four rays. The effect is reversible with temperature. Probable mechanisms are discussed. (J.S.R.)

26076 STUDIES WITH EPR OF SOME FREE RADICAL PRODUCTS FROM IRRADIATION OF SOLIDS AT LOW TEMPERATURE. R. Bensasson, K. Leibler, R. Marx, and H. Szwarc. Compt. rend. colloq. ampère, 9e colloq., Pise, 1960, p.303-11. (In French)

Electron paramagnetic resonance was used to study the free radicals formed and their evolution in the solid phase in cyclohexane and its iodide, bromide, and chloride derivatives and in four vinyl monomers: acrylonitrile, methacrylonitrile, methyl acrylate, and methyl methacrylate. The experimental technique is described in some detail. Cyclohexane and its derivatives gave spectra with the same characteristics, but with different beam width. It is suggested that in the irradiation the free radical produced is the cyclohexyl radical. In cyclohexane chloride a doubling of the spectrum is observed during temperature increase. The radical yields were determined, and the temperature regions of recombination were measured. The resonance spectra obtained for the vinyl monomers are given, and the changes observed after heating to the fusion temperature are shown. After fusion the presence of the polymer was detected. The radical yields measured are of the order of 0.2 to 0.4 and appear to depend on the crystallization conditions. (J.S.R.)

26077 NUCLEAR QUADRUPOLE RESONANCE IN IRRADIATED CRYSTALS. J. Depireux, N. Cornet, M. Read, and J. Duchesne (Université, Liège). Compt. rend. colloq. ampère, 9e colloq., Pise, 1960, p.661-3. (In French)

It has been suggested that the utilization of a resonating molecule as a "probe" would permit the study of the effect of the radiation on the principal constituent of the solid solution even if the solution itself has no carrier nucleus of a quadrupole moment. To test this hypothesis, solid solutions of p-dichlorobenzene in durene, guaiene, naphthalene, and anthracene were prepared, and the solutions were exposed to gamma radiation. In the substances studied, the intensity of the beam of Cl^{35} in p-dichlorobenzene followed, as a function of the dose, the exponential law valid for the pure substances. None of the curves of radiosensitivity of the solid solutions coincide with that of the probe molecule. The durene and guaiene solutions have a lower radioresistance than the pure p-dichlorobenzene, but the naphthalene and anthracene solutions have a greater radioresistance. (J.S.R.)

26078 NUCLEAR POLARIZATION DYNAMICS OF IRRADIATED POLYTETRAFLUOROETHYLENE. G. Hardeman (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). Compt. rend. colloq. ampère, 9e colloq., Pise, 1960, p.669-73. (In French)

The dynamic polarization of F^{19} was studied in polytetrafluoroethylene irradiated with 1-Mev electrons. Its value was determined for different concentration of paramagnetic centers as a function of the exterior magnetic field and of the intensity of the polarizing microwave field. The saturation of the normal paramagnetic resonance was also determined. If the Abragam description of the effect is applied by considering that the paramagnetic resonance beam is broadened inhomogeneously and that the polarization is distributed in the material by the nuclear spin-spin interaction, a general expression of the polarization is found as a function of the concentration of the paramagnetic centers, of the microwave power, and of the value H of the stationary magnetic field. With respect to the order of magnitude, the effect calculated agrees with the experimental results. The variation, as a function of the field H, has, however, a disagreement which can not be explained with the aid of the model on which the calculations were based. (tr-auth)

26079 POLYMERIZATION OF NITROETHYLENE BY GAMMA IRRADIATION. V. N. Sokolov, I. Ya. Poddubnyi, V. V. Perekalin, and V. F. Evdokimov. Doklady Akad. Nauk S.S.S.R., 138: 619-20(May 21, 1961). (In Russian)

A Co^{60} source (1450 g-equivalents of Ra) with an output of 0.28 to 0.72 million r per hour was used to irradiate purified nitroethylene monomer in glass ampoules at 20°C. The unreacted monomer was distilled away, and the weight of the residual polymer was taken to determine the yield. At doses $> 5 \times 10^6$r, the polymer and monomer interact further to give a solid block of polymer instead of the powdery polymer that is usually observed. The block form of the polymer does not form at dose strengths $> 0.3 \times 10^6$ r/hr. Partial polymerization of the nitroethylene takes place even after removal of the Co^{60} sources with the formation of the block form of polymer. Since hydroquinone and oxygen inhibit the polymerization reaction, it is concluded that relatively long-lived polymeric radicals are formed during irradiation. The block polynitroethylene is insoluble in ordinary solvents, but is readily soluble in N,N-dimethylformamide. Its molecular weight is 38,000 (from viscosity measurements) and its density is 1.535. Analyses showed that no denitration took place. X-ray analysis showed that the polymer was not crystalline, but an intense narrow halo was observed at 5.15 A, and a weaker wider halo at 3.73 A. It was found that nitroethylene copolymerizes with other unsaturated nitro compound such as, for example, 1,4-dinitrobutadiene-1,3. (TTT)

26080 ANGULAR DISTRIBUTION OF DISPERSED PARTICLES DURING THE IRRADIATION OF A SINGLE CRYSTAL BY AN IONIC BEAM. V. A. Molchanov, V. G. Tel'kovskii, and V. M. Chicherov (Scientific Research Inst. for Nuclear Physics, USSR and Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 138: 824-5(June 1, 1961). (In Russian)

When single crystals are irradiated by an ion beam, the atoms leaving the system form a special pattern ("Wehner spots") on the collector. The angular distribution of the dispersed material leaving the target was investigated by irradiating a Cu single crystal with argon beam having an energy of 27 kev and using an x-ray film, supported by a flat or curved Cu plate as the collector. After irradiation of the (100) face of the crystal, four symmetrical and one central spots were obtained, corresponding to the (110) and the (100) crystal axes, respectively. Blackening of the film was found to be proportional with the thickness of the deposited layer. Microphotographic studies showed that most of the atoms leaving the target crystal are located within cones with a half-angle of about 20°. The intensity of the blackening caused by the spots depends on the plane of the crystal face cut. (TTT)

26081 FORMATION OF HYDRAZINE BY THE GAMMA-IRRADIATION OF LIQUID AND SOLID AMMONIA. Yu. A. Sorokin and S. Ya. Pshezhetskii (Karpov Physico-Chemical Inst., [USSR]). Doklady Akad. Nauk S.S.S.R., 138: 880-3 (June 1, 1961). (In Russian)

In order to establish the effect of the phase state on radiation chemical processes, the formation of hydrazine in liquid and solid NH_3 irradiated by gamma-rays from a 2.10^4 curie Co^{60} source was investigated, varying the radiation rate from 25 to 790 r/sec and the duration of the experiments from 10 to 10^4 sec. The specimens were kept in quartz containers during the irradiation. After the test, the NH_3 was evaporated and the hydrazine was determined by a photocalorimetric method with a precision of 10^{-1} mg/ml. Lowering the temperature of the liquid phase, the hydrazine yield was found to increase but it decreased after the freezing point of NH_3 was reached at −78°C, being about an order of magnitude lower than in the liquid phase. The temperature dependence of the yield in the liquid corresponds to an energy of activation of about 3 to 4 Kcal/mol. The negative temperature dependence is probably due to the decomposition of the product formed. The hydrazine is probably formed by recombination of the NH_2 radicals and the interaction of the NH radical with NH_3. At sufficiently high rates a stationary yield value should be reached where the formation and decomposition rates are identical; this point has not been reached during the tests. The negative temperature coefficient could also result from the diffusion of the NH_2 radicals; this agrees well with the energy of activation found. (TTT)

26082 THE APPLICABILITY OF ALLEN'S MODEL TO THE RADIOLYSIS OF AQUEOUS SOLUTIONS. V. G. Firsov and B. V. Ershler (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 884-5(June 1, 1961). (In Russian)

The H and OH radicals formed by the radiation partially recombine yielding H_2, H_2O, and H_2O_2 molecules and partially diffuse away. If at a level I_1 a certain relationship is established between two particles of a radiolytic process, then at a radiation level I_2 the curve will shift by (I_1/I_2) on the logarithmic axis, remaining parallel with the original curve. This question was studied in the case of the radiolysis of Ti salts by determining the radiolytic yield of oxidized trivalent Ti sulfate as a function of $\log(Ti^{3+})$. Radiation rates of $I_1 = 0.0364 \cdot 10^{19}$ ev/liter sec and $I_2 = 1.00 \cdot 10^{19}$ ev/liter sec from a Co^{60} source were used. The oxidiation yield was found to increase first slowly with increasing concentration, followed by a sudden decrease. Both curves had the same shape and were located within 0.70 to 0.72 of each other on the logarithmic axis, agreeing quite well with the ratio of $I_1/I_2 = 0.72$, thus proving that Allen's model may be used in this case. The dependence of the yield on the radiation intensity proves the interaction of the particles generated during the irradiation. The reaction follows the laws of homogeneous kinetics. (TTT)

26083 ON THE GAMMA IRRADIATION OF AQUEOUS SOLUTIONS OF MALEIC AND FUMARIC ACIDS. E. Lazzarini and A. Piscitelli (CESNEF, Milan and Istituto di Fisica del Politecnico, Milan). Energia nucleare (Milan), 8: 406-8(June 1961). (In English)

The radiolysis of fumaric and maleic acids, and the existence of succinic acid in their γ irradiation products are investigated in aqueous solutions. Neither isomerization, nor any difference between the cis and trans isomers, is found. The number of molecules destroyed/100 ev absorbed is found as a function of the acid concentration, from $5 \cdot 10^{-5}$ to $2.5 \cdot 10^{-2}$M. No succinic acid is observed in the irradiation products. (T.F.H)

26084 A LOW-BACKGROUND LABORATORY. H. W. Wilson, D. E. Watt, and D. Ramsden (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Intern. J. Appl. Radiation and Isotopes, 10: 156-66(July 1961). (In English)

Consideration of the design, cost, and construction of a low-background laboratory for the measurement of low specific activity samples leads to the choice of demineralized water as the main shielding material. Background figures and spectra obtained for a range of proportional and scintillation counters in the completed laboratory, show that the shielding is slightly better than 12 in. of steel. It is deduced from energy and intensity measurements that the gamma-ray peaks occurring in the background spectrum arise mainly from ThC'' present in the counter construction materials. (auth)

26085 DOUBLE LABELLING OF SODIUM MONOFLUOROPHOSPHATE WITH P^{32} AND F^{18}. Y. Ericsson (Royal Dental School, Stockholm). Intern. J. Appl. Radiation and Isotopes, 10: 177-80(July 1961). (In English)

The preparation of $F^{18}P^{32}$-labelled sodium monofluorophosphate is described. The principles of the preparation are given along with different tests which demonstrated a high degree of purity of the preparations. (auth)

26086 GAMMA RADIOLYSIS OF CARBON-14 LABELED ISOBUTANE. J. Kivel and A. F. Voigt (Ames Lab., Ames, Iowa). Intern. J. Appl. Radiation and Isotopes, 10: 181-90 (July 1961). (IS-145) (In English)

The use of radioisotope labeled compounds and gas chromatographic techniques was applied to a study of the decomposition of liquid and gaseous C^{14} labeled isobutane by cobalt-60 gamma radiation. Results are presented in terms of the G values of the radiation products. The specific activity of propane produced from isobutane-2-C^{14} was found to be about 1.5 times greater than that from isobutane-1-C^{14}. Similar results were obtained for propylene. Carbon-14 activity was not found in the methane product when isobutane-2-C^{14} was irradiated. The isobutene yield was unaffected by changing the labeled compound. The yield of neopentane was considerably greater than that of isopentane. Effects of temperature on hydrogen and methane formation are given and explained in terms of molecular and radical processes. Several mechanisms are presented for the formation of these radiation products. (auth)

26087 EFFECT OF SOLID ADDITIVES ON THE POLYMERIZATION OF ETHYLENE AND ON THE TELOMERIZATION OF CARBON TETRACHLORIDE AND ETHYLENE INITIATED BY GAMMA RAYS. C. Mechelynck-David and F. Provoost (Centre d'Etude de l'Energie Nucléaire, Mol-Donk, Belg.). Intern. J. Appl. Radiation and Isotopes, 10: 191-7(July 1961). (In French)

The rate of disappearance of ethylene in the presence of solid additives was studied in two reactions initiated by gamma rays. The solids were: solids with large specific surface area such as silica gel, alumina, molecular sieves, and activated charcoal; oxides with small specific surface area such as zinc oxide, silica gel calcined at 700°C, and quartz wool; and polyethylene powder. The rate of polymerization of ethylene was increased 20 to 50 times when 4.2×10^{-3} mole ethylene was polymerized in the presence of 1 g of polar microporous solid. The polar catalysts of small surface area had no effect on the polymerization rate whereas charcoal was an inhibitor of this reaction. For the addition of carbon tetrachloride to ethylene, no important catalytic effect was observed in a reaction medium containing 2×10^{-2} mole carbon tetrachloride, 1×10^{-2} mole ethylene, and 1 g of solid of any type. These effects are discussed. (auth)

26088 THE MIGRATION OF RADIATION DAMAGE IN REDUCED GLUTATHIONE. Thormod Henriksen and Alexander Pihl (Norwegian Radium Hospital, Oslo). Intern. J. Radiation Biol., 3: 351-9(July 1961).

The migration of radiation induced unpaired spins in reduced glutathione was followed by qualitative and quantitative electron-spin-resonance (EPR) measurements. Polycrystalline glutathione was irradiated with 220 kv x rays and kept in vacuum at room temperature. Ten minutes after exposure the spectrum resembled that of an equimolar mechanical mixture of the three constituent amino acids. In the course of days the spectrum changed to become finally almost identical with that of irradiated cysteine. The spectrum of the mechanical mixture was shown to be a simple sum of those of the constituent amino acids in which the majority of EPR centers reside in the glutamic acid and glycine. The data indicate that in irradiated glutathione EPR centers are initially induced in all three amino acid residues. Subsequently, the EPR centers are slowly transferred to the cysteine part. The transfer may involve an interaction between radiation-induced molecular fragments and intact neighboring glutathione molecules. (auth)

26089 ELECTRON SPIN RESONANCE OF γ-IRRADIATED GLYCYLGLYCINE. Mikio Katayama and Walter Gordy (Duke Univ., Durham, N. C.). J. Chem. Phys., 35: 117-22(July 1961).

The electron paramagnetic resonance spectra of a gamma-irradiated single crystal of α-glycylglycine were measured at 9, 24, and 29 kmc/sec for various orientations of the crystal in the external magnetic field. The free radical structure produced by gamma irradiation is shown. The electron spin density of the $-CH$ carbon atom is evaluated as approximately 0.75. (auth)

26090 PARAMAGNETIC RESONANCE OF X-IRRADIATED SINGLE CRYSTALS OF ROCHELLE SALT. Grace C. Moulton and W. G. Moulton (Univ. of Alabama, University). J. Chem. Phys., 35: 208-12(July 1961).

The electron-spin resonances of single crystals of Rochelle salt and deuterated Rochelle salt irradiated with 40 kv x rays were studied as a function of orientation of the crystal in the magnetic field. The spectra are time dependent, and by studies of the decay of the spectra it was found that three kinds of centers are present. In Rochelle salt one of these gives rise to an intense doublet which decays rapidly, another to a doublet which grows and then decays, and the third is an eight-line spectrum which grows and is stable. It is shown that the waters of hydration play an important role in the kinetics of the growth and decay of the centers. The stable spectrum was analyzed, and it is concluded that two of the lines arise from breaking one of the C–H bonds. The doublet is slightly anisotropic, and arises from hyperconjugation to the proton on the adjacent carbon, and dipolar coupling between it and the large spin density on the carbon. A second pair of lines arises from breaking the other C–H bond, and since the hydrogens are not equivalent, the pair has a different splitting. The other two pairs are shown to be couplings to either OH or water of hydration hydrogens. (auth)

26091 USE OF MASS SPECTRAL DATA IN RADIATION CHEMISTRY. Jean H. Futrell (Aeronautical Research Lab., Wright-Patterson AFB, Ohio). J. Chem. Phys., 35: 353-6(July 1961).

The quasi-equilibrium theory of mass spectra is applied to the propane molecule ion to calculate the extent of unimolecular dissociation at 10^{-10} sec. The collision time is approximated for propane at moderate pressures and is therefore the ion distribution appropriate to irradiation studies. Two formulations of the theory are used, and it is concluded that the analytical mass spectrum of paraffin hydrocarbons is a good first approximation of the ion distribution in irradiated systems. (auth)

26092 FURTHER NOTES ON THE MAGNETIC CENTERS IN NEUTRON-IRRADIATED CALCITE. James C. Kemp (Univ. of California, Berkeley). J. Chem. Phys., 35: 377-8(July 1961).

The spectrum seen at temperatures greater than 77°K s show complexities including the emergence of lines with longer T, and T_2. At 300°K the A lines appear replaced by a single line, denoted A , at about the center of gravity of the A lines, and an entire new complex of very narrow, easily saturable lines, denoted the α lines, shows up at temperatures above 200°K (depending on concentration). Several lesser lines are also seen. An absorption peak at about the ν_3 CO_2 stretching vibration frequency, with intensity increasing with irradiation dosage and ESR intensities was observed. A CO_2 model might explain the replacement of the three A lines by the A′ line at high temperatures. (P.C.H.)

26093 ISOLATION OF CARRIER FREE RHODIUM FROM RUTHENIUM TARGETS. M. H. Kurbatov and C. W. Townley (Ohio State Univ., Columbus). J. Inorg. & Nuclear Chem., 18: 19-23(Mar. 1961). (In English)

The process used included (a) solution of the ruthenium metal in a mixture of nitric and hydrochloric acids under pressure at 200°–220° in sealed tubes, (b) distillation of ruthenium oxide from perchloric acid solution, (c) conversion of the perchloric acid solution of rhodium to hydrochloric acid solution, (d) removal of Cu^{64} and Zn^{65} from the chloride solution by adsorption of the zinc and copper ions on filter paper, (e) removal of K^{42} by adsorption of rhodium ions on paper from perchlorate solution, and (f) recovery of the rhodium from the filter paper by solution in hydrochloric acid. This procedure resulted in a yield of 85 per cent of the total rhodium free from ruthenium, contaminants, and rhodium carrier. The time required for the separation and preparation of samples for the β-spectrometer is about 10 hr. (auth)

26094 HEAT PRODUCED UPON NEUTRON IRRADIATION OF CONTAINERS OF VARIOUS MATERIALS AND ITS EFFECT UPON THE NEUTRON ACTIVATION PRODUCTS OF DISODIUM PHOSPHATE. T. R. Sato and H. H. Strain (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 18: 24-31(Mar. 1961). (In English)

The neutron irradiation of disodium phosphate in glass containers was often accompanied by secondary, chemical condensation of the phosphate to pyrophosphate. This condensation was produced by the action of heat, which was liberated in the containers themselves. The heat liberated was a function of the boron content of the containers and the neutron flux of the reactor. For the maintenance of low temperatures during neutron irradiation of various substances, containers of pure silica (quartz) or polyethylene are most effective. In the absence of thermal reactions, neutron activation of phosphate did not produce splitting or condensation of the phosphate group. (auth)

26095 THE RADIOLYSIS OF n-PROPYL BROMIDE. Richard J. Neddenriep and John E. Willard (Univ. of Wisconsin, Madison). J. Phys. Chem., 65: 1206-13(July 1961).

The radiolysis of degassed liquid n-propyl bromide by Co^{60} γ rays produces no elemental bromine, but yields HBr with initial G-values of 0.06, 0.12, 2.9, and 10.5 at −78, 0, 25, and 50°, respectively. At 25 and 50° G(HBr) decreases to zero with increased time of irradiation, the steady-state

concentration at 50° being three times as great as at 25°. A brownish nonvolatile telomer is formed with an estimated G, for C_3H_6 groups incorporated, of 0.09, 0.6, and 4.3 at 0, 25, and 50°, respectively. Added Br_2 increases G(HBr), decreases $G(C_3H_6)$, and eliminates telomer formation. Added C_3H_6 increases telomer production. In the presence of 1 mole % or greater of added HBr or with an O_2 concentration of 0.06 mole % or higher, elemental bromine is produced. These and related data on hydrogen, hydrocarbon, and organic bromide production reveal the existence of a number of competing elementary reactions some of which are temperature dependent. (auth)

26096 ON THE MECHANISM OF WATER RADIOLYSIS. V. V. Voevodskii (Inst. of Chemical Physics, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 14-20(Jan.-Feb. 1961). (In Russian)

Data on the radiolysis of dilute aqueous solutions show the inadequacy of the present radical theory of radiation decomposition for explaining the effects of small admixtures. The possibility of excitation migration along the system of hydrogen bonds to the admixture molecule is postulated. A scheme that assumes the formation of "hot" H atoms and OH radicals is given for explaining the numerical magnitudes of the initial yields of radiolysis products. (tr-auth)

26097 RADIOCHEMICAL STUDIES OF THE DEHYDRATION CATALYSIS MECHANISM. I. INTERACTION OF C^{14}-DIMETHYL ETHER WITH ALCOHOLS AND HYDROCARBONS. V. E. Vasserberg, A. A. Balandin, and G. I. Levi (Zelinskii Inst. of Organic Chemistry, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 61-5(Jan.-Feb. 1961). (In Russian)

It is shown that in C^{14}-dimethyl alcohol reactions with C_2H_5OH and iso-C_3H_7OH and other products of dehydration (ether, and olefin in contact with Al_2O_3 catalyzer at 316 to 320°C and 1 atm, the label moves from the dimethyl ether to olefin, ethyl alcohol, and diethyl ether. The mechanism of intermediate complex reactions on the catalyst is discussed. (tr-auth)

26098 PROBLEMS ON KINETICS AND MECHANISMS OF RADIATION-CHEMICAL REACTIONS. Yu. A. Kolbanovskii (Second All-Union Conference on Radiation Chemistry). Kinetika i Kataliz, 2: 154-9(1961). (In Russian)

A review is given of reports presented at the All-Union Conference held by the Department of Chemical Studies of the Academy of Sciences, USSR, and by the National Committee of the Council of Ministers on Chemistry in Moscow, Oct. 10-14, 1960. Subjects covered included the effects of radiation on aqueous solutions, organic matter, and polymers. (R.V.J.)

26099 FORMATION OF 5-HYDROXYTRYPTAMINE IN AN AQUEOUS SOLUTION OF 5-HYDROXYTRYPTOPHAN TREATED WITH X-RAYS. M. Jovic and Z. Supek (Institute Rudjer Bošković, Zagreb). Nature, 191: 383-4(July 22, 1961).

5-Hydroxytryptamine was found in an aqueous solution of hydroxytrytophan exposed to 300 kv x radiation for 10 hr. It was noted that 5-hydroxytryptamine in aqueous solution undergoes many changes in structure under the influence of different oxidizing agents. It was concluded that the low amount of 5-hydroxytryptamine formed was due to the action of the various oxidizing species produced by x radiation. (C. H.)

26100 FREE RADICALS IN IRRADIATED NYLON. D. S. Ballantine and Y. Shinohara (Brookhaven National Lab., Upton, N. Y.). Trans. N. Y. Acad. Sci., (II), 23: 433-6(Mar. 1961).

Low crystallinity nylon 6-filaments were gamma irradiated. The behavior of the free radicals produced was then followed under varying conditions of time and storage environment. From the results it was interpreted that the irradiation is capable of producing radicals by a random bond rupture, but these radicals are not fixed at their initial site of formation. They are capable of migration along the polymer chain by a process of hydrogen atom transfer but are stabilized or localized to some degree in the vicinity of the amide group because of resonance considerations. Observations of a five-peak spectra are also discussed. (P.C.H.)

26101 DEVELOPMENT TRENDS AND TECHNICAL ASPECTS OF RADIATION CHEMISTRY. G. O. Schenck (Max-Planck-Institut für Kohlenforschung, Mülheim an der Ruhr, Ger.). Umschau Fortschr. Wiss. u. Tech., 61: 357-61(June 15, 1961). (In German)

For the resolution of chemical transformations it is, in general, necessary that a determined energy addition be supplied in a suitable manner to the reaction participants. In most cases this "activation energy" is supplied thermally, i.e., by heating the environment. This is also the case in biological processes and in reactions which require catalysts. In radiation chemistry the activation energy is received by absorption of optical or ionizing radiation. In the present article the present and future technical problems and possibilities of radiation chemistry are treated. The occasional very important task of the prevention of undesired radiation-chemical transformations is considered. (tr-auth)

26102 IMPROVEMENTS IN OR RELATING TO A PROCESS FOR THE PRODUCTION OF BODIES OF CROSS-LINKED POLYMERIC MATERIAL. (to Siemens-Schuckertwerke A. G.). British Patent 870,381. June 14, 1961.

A process for crosslinking a polymeric material is described in which the powdered polymeric material is irradiated in a stream of inert gas and then worked to form a body of the crosslinked material. The radiation used preferably is u-v radiation or radiation from radioactive waste materials. The advantage of this process is that, for polyethylene, its memory effect is avoided. (D.L.C.)

26103 IMPROVEMENTS IN OR RELATING TO MODIFIED NATURAL POLYMERS. (to E. I. du Pont de Nemours and Co.). British Patent 875,664. Aug. 23, 1961.

Graft polymers may be made by exposing a substrate of natural or modified natural polymers to ionizing radiation and contacting, either simultaneously or subsequently, with one or more polymerizable monomers which contain carbon unsaturation and acid groups. Variations of the method and the properties of the resulting graft polymers are discussed. (D.L.C.)

Raw Materials and Feed Materials

26104 (AEC-tr-4514) TECHNOLOGY OF THE TREATMENT OF URANIUM CONCENTRATES. (Tekhnologiya Pererabotki Kontsentratov Urana). N. P. Galkin, A. A. Maiorov, and V. D. Veryatin. Translated from a publication from the Publishing House of the Main Administration on the Use of Atomic Energy with the Council of Ministers, USSR, Moscow, 1960. 144p.

Special attention is devoted to describing the theoretical principles underlying the processes of treating uranium concentrates to produce the pure salts and metal. Data

published in foreign and native literature through September of 1958 are utilized, and modern achievements of industry and science are taken into account. The subjects included are: history of the development of the uranium industry; fields of uranium usage; properties of uranium and its ions in solution; uranium ores and concentrates; production of uranium concentrates; methods of purifying uranium; methods of purifying uranium concentrates; preparation of uranium oxides; methods of preparing uranium tetrafluoride; preparation of uranium tetrafluoride by a gaseous method; preparation of metallic uranium; combination processes for purifying uranium concentrates; and safety practices in the purification of uranium concentrates. 261 references are included. (P.C.H.)

26105 SCANDIUM RECOVERY FROM URANIUM SOLUTIONS. L. D. Lash (Vitro Chemical Co., Salt Lake City, Utah) and J. R. Ross. J. Metals, 13: 555-8(Aug. 1961).

The commercial recovery of scandium as a by-product of uranium extraction is described. A fluoride strip system is developed to recover scandium from the solvent in concentrated form, and high purity scandium oxide is prepared in multi-pound lots by chemical separation techniques. (auth)

Separation Processes

26106 (AERE-R-3404) THE SEPARATION OF MILLIGRAM AMOUNTS OF CAESIUM FROM A LARGE EXCESS OF AMMONIUM SALTS. A. G. Pratchett (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). June 1961. 8p.

The development of a technique for the separation of milligram amounts of cesium ions from more than a hundred grams of ammonium or sodium salts is described. The separation is achieved at a pH of 13 using a sulphonated-phenolic type of cation exchange resin. Only milligram quantities of sodium or ammonium ions follow the cesium and these may readily be separated by conventional precipitation procedures. (auth)

26107 (CEA-1789) PROBLEMS POSES PAR LA FILTRATION ET LE PRELEVEMENT DES AEROSOLS DANS LE CADRE DE L'ENERGIE ATOMIQUE. (Problems Presented by the Filtration and Sampling of Aerosols in the Atomic Energy Programme). Roland Cochinal (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1959. (DE/SEA-1155/675)

Communication presented at the 5th International Colloquium on Dusts in Industry, Paris, March 19-21, 1959.

The maximum permissible limits for radioactive aerosols are much lower than those for aerosols encountered in the non-nuclear industries. These limits depend on numerous factors such as nature of the radiation, half-life, etc. The filtering of the air in high activity laboratories or in plutonium treatment factories necessitates an installation consisting of aspiration filters and extraction filters of very high efficiency (those used for α emitter cells: designed to be replaced without incurring contamination risks; those used for γ emitter cells: designed to be replaced by remote control. The filtering in nuclear reactors is also effected by filter papers: (1) The G1 reactor with open circuit: the air coolant is entirely filtered at the entry and on leaving. (2) The G2, G3, and EDF1 reactors with closed circuits: filtering under pressure of a small portion of the coolant gas. (auth)

26108 (CF-61-3-141) CHEMICAL TECHNOLOGY DIVISION, CHEMICAL DEVELOPMENT SECTION C. PROGRESS REPORT FOR FEBRUARY–MARCH 1961. K. B. Brown (Oak Ridge National Lab., Tenn.). Aug. 15, 1961. 54p.

Thorium recoveries in sulfuric acid leaching were not improved by grinding granite to −200 mesh rather than −48 mesh, and acid consumption was higher for the finer ore. Study of thorium solubility in the leach liquors indicated that leaching efficiency should not be limited by thorium solubility, at least below pH 1.5. Approximately 0.5 g quantities of >97% ThO_2 were recovered from Pikes Peak and Silver Plume granites by an acid leach-solvent extraction flowsheet. Primary amines extracted Th from the leach liquor very effectively ($E_a^0 > 2000$). Preliminary leaching results with bauxite and pumice, two other potential low grade thorium sources, were not promising. Additional studies are reported for extraction of cesium from simulated Purex 1WW by sodium tetra phenyl boron ($Na\phi_4B$) in hexone. Extraction and stripping coefficients for cesium are sufficiently large for process use. However, estimated processing costs are high due to the high prices quoted for the $Na\phi_4B$. In development of flowsheets for final cycle plutonium recovery by extraction with amines, extraction isotherms from 1.5 M HNO_3 were extended and compared with extractions from HNO_3 containing added H_2SO_4: $E_1 = 3300$ with zero H_2SO_4, 1200 with 0.032 M H_2SO_4, 400 with 0.113 M H_2SO_4, and 120 with 0.334 M H_2SO_4 (each in 1.5 M HNO_3) in the empirical expression $E_a^T(Pu) = E_1 [\underline{M}_{amine} - 3\underline{M}_{Pu}]^2$. The extractant was ~0.3M trilaurylamine in Solvesso 100. This empirical expression gives better over-all fit to the extraction isotherms than the slightly different expression used previously. Progress was made in development of methods for the stripping without contaminating the product solution with residues such as Fe and sulfate or unstable reductants, by stripping with oil-soluble reductants, particularly di-tert-butylhydroquinone, and by stripping with acetic acid. Extraction of Zr–Nb-95 tracer by variously-treated amine extractants showed detectable amounts of strong zirconium extractant produced by long contact of amine with moderate to high concentrations of nitric acid; scrubbing with chromate decreased the ability to extract Zr–Nb tracer in a subsequent contact. In continued studies of the separation of transplutoniums from lanthanides by extraction with tertiary amines, data have been obtained for extraction of Am^{241} from 8 N LiCl, 2 N $AlCl_3$ by 0.5 M TIOA in 24 different diluents. Data were also obtained on the effect of low concentrations of acid on extraction from 11 N LiCl. Possible improvements in a process flowsheet have been indicated. (auth)

26109 (HW-68931) RECUPLEX CONTINUOUS DISSOLVER. L. E. Bruns (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 27, 1961. 14p.

A continuous dissolver of the recirculation type is described for dissolving Pu-bearing slag and crucible to give a product containing negligible Pu solids and extractable in a Recuplex solvent system. A flowsheet is included. (D.L.C.)

26110 (IDO-14359) TESTING A HALF-SCALE PROTOTYPE OF THE ICPP CONTINUOUS DISSOLVER FOR ALUMINUM FUEL ALLOYS. A. F. Boeglin and J. A. Buckham (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 9, 1955. Decl. Feb. 3, 1961. Contract AT(10-1)-205. 26p.

The continuous dissolution of aluminum and uranium–aluminum alloy slugs by mercury-catalyzed nitric acid in a five-inch diameter tall pipe dissolver vessel was studied. Continuous dissolution of the metal elements was accom-

plished in the stainless steel dissolver by the continuous addition of 5.6M nitric acid and the injection, at the required rate, of 1.125M mercuric nitrate solution to the bottom of the dissolver, the addition, at a prescribed rate, of the metal elements to the top of the dissolver, and the removal of the dissolver solution or effluent from an intermediate point of the dissolver. Over twenty runs were made under various operating conditions and in general the results were highly satisfactory and verified both the scale-up equations and the operability of the plant dissolver. (auth)

26111 (IDO-14552) REPROCESSING URANIUM FROM THE FIRST OMRE CORE. A. L. Ayers and G. J. Raab (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 9, 1961. Contract AT(10-1)-205. 9p.

Recovery of U from the first Organic Moderated Reactor Experiment core is reported. Dissolution, feed preparation, and first cycle extraction were accomplished in existing equipment designed to process the Submarine Intermediate Reactor fuel. The elements were dissolved in nitric acid–sulfuric acid solution and the U extracted with TBP. Two additional extraction cycles were carried out using hexone in the 25 process. (J.R.D.)

26112 (NAA-SR Memo-6393) OXIDATIVE DECANNING OF IRRADIATED UO_2. J. E. Bodine and J. Guon (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 10, 1961. 15p.

Stainless-steel clad, uranium dioxide pellets irradiated to a burn-up of 15,000 Mwd/MTU were remotely decanned using gas-phase, oxidative processing. This level of irradiation had no detrimental effect on decanning rates. Decanning rates were established for a range of temperatures and pressure, the optimum conditions being 465°C and 15 inches Hg absolute oxygen pressure. Perforating the tubes containing irradiated oxide at $1\frac{1}{2}$ inch intervals increased decanning rates by a factor of 8 to 10. The powder removed from perforated tubes was coarser than that from unperforated tubes. (auth)

26113 (ORNL-3101) PROCESSING OF URANIUM CARBIDE REACTOR FUELS. I. REACTION WITH WATER AND HCl. M. J. Bradley and L. M. Ferris (Oak Ridge National Lab., Tenn.). Aug. 15, 1961. Contract W-7405-eng-26. 21p.

High-purity uranium monocarbide reacted with water at 80°C to produce a finely divided, brown U(IV) compound, and 92 ml (STP) of gas per gram consisting of 11 vol % hydrogen, 86 vol % methane, 2 vol % ethane, and 0.6 vol % propane. At 90°C, the products were the same, but the reaction rate was higher. Reaction with 5.6 M HCl was slower than with water, but the gaseous products were essentially the same. In preliminary experiments at 80°C with UC–UC_2 mixtures containing less than 2 wt.% free carbon, the volume of gas evolved per gram of sample hydrolyzed decreased from 92 to 32 ml (STP) and the methane concentration from 86 to 14 vol % as the UC_2 concentration in the mixture increased from 0 to about 63 wt.%. An attendant increase in the hydrogen and ethane concentrations to 23 and 38 vol %, respectively, also occurred. (auth)

26114 (ORNL-3147) A SURVEY OF THE HAZARDS INVOLVED IN PROCESSING LIQUID METAL BONDED FUELS. J. B. Adams (Oak Ridge National Lab., Tenn.). Aug. 14, 1961. Contract W-7405-eng-26. 19p.

A survey of the character and magnitude of hazards involved in processing liquid metal bonded fuels was made and the scope of a preliminary experimental program outlined. Processing of SRE and CPPD fuels by mechanical decladding followed by controlled reaction of the collected NaK and Na is recommended over chemical dejacketing methods. Similarly, shearing of PRDC fuel and controlled exposure of the Na in the severed portions to water appears more desirable than chemical dissolution of the metallic cladding. (auth)

26115 (TID-11692) THE DOW ALUMINUM PYROMETALLURGICAL PROCESS. Annual Technical Progress Report Fiscal Year 1960. Robert J. Teitel and Gilbert S. Layne (Dow Chemical Co., Midland, Mich.). Aug. 19, 1960. 180p. Contract AT(11-1)-768.

In the Dow Al Pyrometallurgical process U is dissolved in molten Al and precipitated as UAl_3 by the addition of Mg. The UAl_3 is dissociated by Mg or Zn treatments and metallic U recovered by heating the product in vacuo. Fission products or other impurities are separated from the U by taking advantage of their properties of volatility or insolubility in Al, or solubility in Al–Mg, Mg, or Zn. The basic steps of the DAP process were evaluated experimentally with respect to fission product and Pu separation, quantities of process metals required, U losses, container material requirements, general basic equipment, and processing techniques. From this information, a flow sheet of the process as it may be applied to an EBR II fast breeder reactor fuel cycle and as a "head-end" process for aqueous processing of U–Zr fuel elements was evaluated with favorable potentialities indicated. Detailed experimental data were obtained on experiments using from 1 to 100 grams of U. The results show that the separation of Ce (and therefore the rare earth fission products), Ba, Sr, Y, Zr, Mo and Ru can be maintained at a reasonably low level in a uranium based equilibrium "fissium" fuel. High recoveries of U from low U–Zr fuel elements were demonstrated. Pu can be recovered from Pu–Al melts by the addition of Mg. Very low concentrations of Pu can be coprecipitated (from these melts) with U. (auth)

26116 (Y-1346) RECOVERY OF NEPTUNIUM-237 BY ION EXCHANGE. E. G. Laggis and C. R. Schmitt (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). July 28, 1961. Contract W-7405-eng-26. 27p.

Adsorption and concentration of neptunium-237 occurring in trace level quantities in uranyl nitrate solutions were accomplished by cation exchange. Subsequent purification by anion exchange for removal of fission products was demonstrated to be feasible. Gamma scintillation spectrometry was found to be a valuable aid in quantitatively assessing radionuclide concentrations in the system's streams. (auth)

26117 (AWRE-Trans-13) ADSORPTION IN FLUIDISED BED. P. G. Romankov, V. N. Lepilin, and E. S. Nemet. Translated by L. J. Goodlet for U.K.A.E.A., Atomic Weapons Research Establishment from Khim. Nauka i Prom., 1: 317-24(1956). 20p.

A study was conducted to establish the effects of hydrodynamic characteristics, concentration conditions, and geometric parameters of fluidized beds on mass transfer in relation to the process of adsorption in a stationary bed. A relationship between the coefficient of mass transfer and the fundamental factors of adsorption was established for use in calculating the useful volume of absorbers of the tubular type as well as the protective action of an adsorbent in fluidized beds. (J.R.D.)

26118 ANALYSIS OF CONTACT EXCHANGE OF ION EXCHANGERS WITH THE AID OF RADIONUCLIDES. E. Blasius and K. D. Beccu (Technische Universität, Berlin). J. Inorg. & Nuclear Chem., 18: 63-78(Mar. 1961). (In German)

Direct ion exchange between two exchangers is called

contact exchange when the working medium does not actively participate in the exchange process. It is caused by surface diffusion of ions to the anchor groups, and is produced in most cases by the diffusion velocity of the ions in the particle. Discrepancies appear with weakly bound ions through hydrolysis of the salt form and the resulting electrolyte exchange. (tr-auth)

26119 GEL LIQUID EXTRACTION. THE EXTRACTION AND SEPARATION OF SOME METAL SALTS USING TRI-n-BUTYL PHOSPHATE GELS. H. Small (Dow Chemical Co., Midland, Mich.). J. Inorg. & Nuclear Chem., 18: 232-44(Mar. 1961). (In English)

The extraction of metal salts from aqueous solution and their chromatographic separation were achieved using solvent swollen polymers. The use of such gels as a means of contacting organic and aqueous phases eliminates the problem of entrainment loss which is often encountered in conventional liquid-liquid extraction techniques. (auth)

26120 ACIDIC ESTERS OF PHOSPHONIC ACID AS SELECTIVE EXTRACTANTS FOR METALLIC CATIONS SELECTED M(III) TRACER STUDIES. D. F. Peppard, G. W. Mason, and I. Hucher (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 18: 245-58(Mar. 1961). (In English)

The extraction of Pm(III), Cm(III), and Cf(III) from aqueous mineral acid phases of constant ionic strength into solutions of (G'O)(G)PO(OH) in toluene as carrier diluent was investigated as a function of hydrogen ion concentration in the aqueous phase, extractant concentration in the organic phase and the nature of G, using the radioactive tracer technique. The distribution ratio, K, defined for a given radioactive nuclide as its concentration in the organic phase divided by its concentration in the aqueous phase, has been found, for each of the M(III) examples studied, to have an inverse third-power dependency upon the hydrogen ion concentration in the aqueous phase and a direct third-power dependency upon the extractant concentration in the organic phase. For both Pm and Cm the value of K_s (an extraction constant empirically defined in the text) increases as G progresses: 2-ethyl hexyl to phenyl to chloro-methyl, the over all range exceeding 10^5. Selected $(G'O)_2PO(OH)$ studies were included for comparison. In the one instance in which a direct comparison was made, in which G was 2-ethyl hexyl, the K_s in the (GO)(G)PO(OH) system was lower than that in the $(GO)_2PO(OH)$ system by a factor of fifty for Pm and 100 for Cm. The effect of a varying μ upon K_s and upon the application of liquid–liquid extraction to the determination of stability constants of metallic complexes in an aqueous phase was investigated briefly. The system, 2-ethyl hexyl hydrogen phenyl phosphonate (in toluene carrier diluent) vs. aqueous HCl + NaCl, $\mu = 1.0$, was demonstrated to differentiate in favor of Cf with respect to Cm by a factor of approximately 105. The same extractant vs. an aqueous HCl phase differentiates between adjacent lanthanides(III) by a factor of 2.8, the log K vs. Z plot being a line of constant positive slope throughout the range studied. The K_s for a specific lanthanide(III) in this system exceeds that in a comparable bis(2-ethyl hexyl) phosphoric acid vs. HCl system by a factor of approximately 200. (auth)

26121 THE EXTRACTION OF URANIUM(IV) FROM NITRIC ACID BY TRI-n-OCTYLAMINE. A. S. Wilson and W. E. Keder (General Electric Co., Richland, Wash.). J. Inorg. & Nuclear Chem., 18: 259-62(Mar. 1961). (In English)

The extraction of uranium (IV) from nitric acid solutions by tri-n-octylamine was studied by a spectrophotometric technique. The data are consistent with the extraction of the hexanitrato anion, as was the case with tetravalent thorium, neptunium, and plutonium previously studied. (auth)

26122 ACTINIDE AND LANTHANIDE ION EXCHANGE SEPARATION STUDIES. II. SEPARATIONS BY AMINOPOLYACETIC ACIDS. J. Fuger (Univ. of Liège, Belg.). J. Inorg. & Nuclear Chem., 18: 263-9(Mar. 1961). (In English)

The dissociation constant of the 1:1 complex BkY^- formed by trivalent berkelium ion with ethylenediaminetetra-acetic acid (EDTA) was calculated from equilibrium distribution measurements of berkelium between a solution of EDTA and the resin Dowex 50-X12. It is found to be $10^{-18.88\pm0.2}$. Column separations have shown that EDTA is an interesting eluting agent both for the separation of trivalent actinide elements from each other and for the purification of the heaviest transplutonium elements from lanthanide fission product elements. In the latter case the actinides with $Z \geq 98$ are eluted ahead of all the rare earth fission products. Reproducibility is improved by buffering the solutions with glycine. Preliminary results with hydroxyethylethylenediaminetriacetic acid (HEDTA) have shown that this eluting agent gives a greater separation of the trivalent actinides from the lanthanide fission products. (auth)

26123 A METHOD OF PROCESSING FUEL MATERIAL OF NUCLEAR REACTORS. (to U. S. Atomic Energy Commission). British Patent 870,691. June 14, 1961.

A method is given for processing reactor fuel materials for separation and recovery of Pu in concentrated form. The method comprises dissolution of a U or Pu oxidic or alloy mass in an alkali metal–aluminum double chloride by heating to 260 to 800°C; a metal phase containing U metal and a salt phase containing Pu in the chloride form are formed. The Pu may be obtained as the metal by adding Ca and/or Mg to the separated salt phase. The formation of Al_2O_3, which hinders dissolution of reactor fuel alloys, may be prevented or reduced by sparging the double chloride melt with CCl_4 vapors in an inert gas. The method is also applicable to the separation of a rare earth, alkaline earth, alkali metal, or thorium from uranium. (D.L.C.)

26124 METHOD OF URANIUM PURIFICATION. (to U. S. Atomic Energy Commission). French Patent 1,228,647. Mar. 14, 1960.

Irradiated U is dissolved in molten Zn or in a molten Zn–Mg alloy, containing 6% Mg, at 700 to 800°C. Mg is added in such a quantity that the eutectic Mg–Zn alloy is formed, which causes the precipitation of U while Pu and the fission products are left in solution. According to a second method the solution of the U in Zn is cooled to a temperature slightly above the m.p. of Zn, e.g. 550°C, and decanted from the separated U_2Zn_{17} crystals. These crystals are mixed at 825°C with enough Mg to form the eutectic Zn–Mg alloy and the mixture is cooled to a temperature slightly above the m.p. of this eutectic. The separated U is finally washed with Mg at 800°C. (NPO)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

26125 (HW-62789) COMMENTS ON EQUIPMENT FOR A P.R.T.R. WATER QUALITY CONTROL LABORATORY. H. J. Anderson and R. E. Perey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1, 1959. Contract AT(45-1)-1350. 3p.

Laboratory space and major equipment pieces needed for a routine water quality laboratory in the P.R.T.R. Building are described. (D.L.C.)

26126 (NP-10426) ANALYSIS AND DESIGN OF EXTERNALLY PRESSURIZED GAS BEARINGS. I. C. Tang and W. A. Gross (International Business Machines Corp., San Jose, Calif.). Apr. 17, 1961. Contract Nonr 3448(00). 51p. (RJ-191)

Equations for flow rate, pressure, load, and stiffness of externally pressurized thrust and journal bearings are given for purely viscous isothermal gas films with longitudinal and radial flow and no relative surface motion. Charts are presented by means of which the bearing characteristics can be evaluated in terms of the bearing configuration, the ratio of supply to ambient pressure, and a bearing parameter. Sample characteristics of thrust and journal bearings are established using the curves, and experimental confirmation shown. A method of treating bearing films with two inlet-restricting orifices in series is described. (auth)

26127 (SCTM-117-61(13)) THE CONTROL AND MEASUREMENT OF MINUTE CURVATURES IN A STEEL SHAFT. Donald F. Wilkes (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 116p.

Several special problems relating to the establishment, adjustment and measurement of small elastic curvatures and the associated strains in a metal shaft are treated. An ultrastable straining frame was constructed to introduce and regulate the curvatures. The frame was calibrated through the use of semiconductor resistance strain gages, and then this calibration was subjected to a direct check and a check by a technique employing optical interference patterns. Various checks upon measuring accuracy and degree of correlation between optically measured curves and theoretical elastic curves were made. A study of existing semiconductor strain gages was made to obtain the most suitable gage for use in the straining frame calibration. (auth)

26128 (SCTM-161-60(24)) EFFECTS OF REVERSED BIAS ON NOISE LEVELS AND TRANSISTOR PARAMETER VARIATIONS IN DIGITAL SYSTEMS. R. D. Moyer (Sandia Corp., Albuquerque, N. Mex.). June 20, 1960. 19p.

The use of the transistor as a switching element is reviewed. Since this switch is electronically controlled, the degree to which it approximates an ideal switch is a critical function of its supporting circuitry. The effects of one feature of the supporting circuitry, namely, reversed biasing is discussed. Specifically, the stability of digital circuits when subjected to transistor parameter variations and low-level noise signals is investigated as a function of the type of biasing employed. (auth)

26129 (TID-4100(1st Rev., Suppl. 10)) ENGINEERING MATERIALS LIST. Richard E. C. Duthie, ed. (Office of Technical Information Extension, AEC). Jan. 1961. 49p.

Lists of engineering materials are presented which include information on computers, critical assemblies, engineering equipment, hot laboratory equipment, hot laboratory structure, instruments, metallurgical equipment and processes, nuclear radiation instruments, nuclear reactors and facilities, and chemical plant designs and processes. (J.R.D.)

26130 (TID-4100(1st Rev. Suppl.13)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Richard E. C. Duthie (Office of Technical Information Extension, AEC). July 1961. 32p.

26131 (TID-13316) EVALUATION OF HELIUM SEAL SELECTED FOR NUCLEAR REACTOR COOLANT COMPRESSORS IN GAS COOLED POWER REACTOR. (Allis-Chalmers Mfg. Co. Milwaukee). Jan. 1961. For Kaiser Engineers. Contract 5918 RD-1. 202p.

A floating-ring or floating-bushing seal was evaluated, which was assembled around a rotating shaft, permitting free radial motion, thus enabling the seal to float on a liquid film and to follow the radial movement of the shaft. The use of a water-buffered floating-ring seal is considered, within the limitations of the studies, to constitute a feasible method for sealing the main gas circulating compressors to be incorporated in the EGCR project. (B.O.G.)

26132 (UCRL-6509) A CIRCULATING LIQUID-NITROGEN-COOLED BAFFLE FOR ULTRA-HIGH VACUUM SYSTEMS. Alfred R. Taylor (California. Univ.; Livermore. Lawrence Radiation Lab.). May 30, 1961. Contract W-7405-eng-48. 14p.

The development and design of a circulating liquid nitrogen baffle for bakeable ultra-high-vacuum systems is described. Liquid nitrogen is circulated through a spiral tube that is brazed to a copper baffle barrel. This assembly is in turn contained in a stainless steel vacuum jacket. The baffle and circulating system is designed for a complex ultra-high-vacuum system requiring eleven diffusion pumps. A four-inch baffle, unbaked, attains a pressure of 3×10^{-9} mm Hg; a baked (250°C) six-inch baffle attains a pressure of 3×10^{-10} mm Hg. There is no apparent size limit to this baffle design. (auth)

26133 (AEC-tr-4482(p.172-91)) A MACHINE FOR GAMMA-RAY RADIOGRAPHY WITH TWO COUNTERS. T. Watanabe.

A gamma radiography method using two counters is described. Since the counting rate depends not only on defects in the sample but also on variations in the sample thickness, a model which is of the same material and shape as the sample to be measured is used. The difference between the countings from the two counters indicates the internal defects of the sample directly. The radiography system consists of a scintillation head, stable high voltage, resistance attenuator, main amplifier, pulse height analyzer, pulse height standard, differential scaler, mixer, rail signal, pen, and recorder. The effect of the shape of the defect on the detected waveform is discussed. (M.C.G.)

26134 (AEC-tr-4482(p.694-712)) EXPERIMENTAL CONSTRUCTION OF A RADIOACTIVE AEROSOL PROCESSING DEVICE. S. Kimura and T. Isahaya.

An experimental model of a wet electric dust collector, with an expected dust-collection efficiency higher than 99% when radioactive aerosol is involved, was constructed. Experimental models of wet, glass-wool mat filters, reverse air jet bag filters, and four types of jet scrubbers were also constructed as mechanical devices for collecting dust. The applicabilities of these devices were compared by the

use of thorium oxides, dusts from monazite ore, uranium oxides, and fumes of $P_2^{32}O_5$. When such factors as dust-collection efficiency, installation costs, and operation costs were considered, it was found that the wet electric dust collector was the most economical. It was concluded that the best method of collecting dust was to use the mechanical dust collectors for rough dust collection, and the wet electric dust collecting device to remove minute particles of of aerosol after appropriate gas adjustment, such as cooling and humidity control. By such a method, an efficiency of 99% was achieved. (M.C.G.)

26135 (AEC-tr-4482(p.713-21)) PERFORMANCE TEST OF A HIGH EFFICIENCY AIR FILTER SYSTEM. S. Fujii.

Experimental devices were constructed for the determination of performance of filtering materials such as filter papers, and devices for the performance testing of unit filters built with such filtering materials. Glass fiber and copper wools were found to be extremely poor collectors for dust particles of a size smaller than 1 micron. Asbesto-cellulose filters were found to be good materials for high efficiency filters. (M.C.H.)

26136 (AEC-tr-4482(p.722-42)) STUDY OF FILTER PAPER (5)—STUDY OF AIR FILTER PAPER. Goro Yobikawa.

A survey was made of past development and future possibilities in the production and use of filter paper. Methods of measuring filtering efficiency including flow rate and resistance studies are described. The effects of thickness on efficiency are discussed. Steps in the production of filter paper are outlined. (M.C.G.)

26137 (AEC-tr-4765) SIDE-CHANNEL PUMPS. Carl Pfleiderer. Translated for Oak Ridge Gaseous Diffusion Plant from p.571-84 of "Die Kreiselpumpen für Flüssigkeiten und Gase Wasserpumpen, Ventilatoren, Turbogebläse Turbokompressoren." (A publication of Springer-Verlag, Berlin, 1955). 35p. (Includes original, 14p.).

The design, performance, and theory of self-priming side-channel pumps for water transport are presented. In these pumps a water ring moved by a star-shaped impeller is used for the control of suction. The impulse-transfer between the impeller and the guiding channel of the sickle-shaped chamber is amplified so that the pressure along the side channel increases rapidly in spite of the uniform cross-section, and 5 to 15-fold heads are obtained in comparison with centrifugal pumps of identical circumferential speed. (N.W.R.)

26138 A METHOD FOR DETERMINING THE POSITION OF RADIOACTIVE SUBSTANCES. G. I. Chernyshev, P. I. Zabrodin, and Ya. A. Pruslin. Byull. Izobret., No. 21, 30-1 (1960).

The method is used to determine the position of a radioactive substance when inspecting the results of a hydraulic rupture of a bed. In order to increase the accuracy of measurement and to obtain more detailed data, gamma-radiation is recorded with two spectrum-sensitive indicators. One of them is used in an area of softer scattered radiation, the other in an area of the harder direct radiation. The position of radioactive substance is determined from the ratio of radiation intensities recorded by both indicators. A variation of the method employs a scintillating gamma-radiation indicator, a rotary screen with windows, and a range analyzer. In order to reduce the sensitivity of one of the indicators to the harder direct radiation, one indicator is fitted with a scintillator in the form of a thin plate. (OTS)

26139 PRESSURE VESSELS FOR GAS-COOLED GRAPHITE-MODERATED REACTORS. M. J. Noone and R. F. Bishop (Whessoe, Ltd., Darlington, Eng.). J. Brit. Nuclear Energy Conf., 6: 253-65(July 1961).

Design and construction principles of pressure vessels for gas-cooled graphite-moderated reactors are presented. Design of the pressure vessel is determined primarily by the general level of stress to be used, the stresses around openings, and the stresses in the region of supports. The stresses determine the plate material and the forging requirements. Welding methods and operations, stress relief methods, and pressure testing of the vessel are also discussed. (N.W.R.)

26140 OBSERVATIONS ON THE DESIGN AND CONSTRUCTION OF THE N. S. SAVANNAH. J. Brit. Nuclear Energy Conf., 6: 266-9(July 1961).

Observations on the design and construction of the N. S. Savannah are discussed. Included in the discussions are collision protection, shipyard requirements, health problems of ship personnel and construction workers, radiation problems, auxiliary power for emergency use in case of reactor failure, design problems of reactor vessel and fuel elements, and construction problems. (N.W.R.)

26141 STRESS ANALYSIS OF RIM REINFORCED OPENINGS IN PRESSURE VESSELS. PART 1. R. Kitching and J. Perkins. Nuclear Eng., 6: 334-8(Aug. 1961).

Elastic stress analysis of rim reinforced openings in pressure vessels is considered. Rim reinforcement of openings is described as the thin rim, duct or pipe, around the opening of the pressure vessel. Formulas are given and discussed for cylindrical and spherical shells. Formulas for the geometric effects on the tangential and radial stresses in the shell and the hoop stress in the branch are given for the interruption of a continuous stress field due to a change of geometry. The effect of an end thrust on a branch is analyzed by the beam on elastic foundation method and the local loading method for the stress due to the dead load of the system. This end thrust is analyzed for tangential, radial, and hoop stresses. Formulas are also given for the three stresses of an end thrust on the branch due to pressure inside the vessel. (N.W.R.)

26142 APPARATUS FOR STORING, HANDLING AND/OR UTILIZING HIGHLY RADIOACTIVE MATERIALS. Robert Bernas. British Patent 873,795. July 26, 1961.

An apparatus for storing and handling a radioactive source is designed with means for indicating whether or not the source is in a protected position. The apparatus comprises a protective mass with a protected position therein, and a radio-resistive detector disposed near the protected position. (D.L.C.)

26143 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR HANDLING RADIOACTIVE MATERIALS FOR USE IN CHARGING AND/OR DISCHARGING A VESSEL SUCH AS THE PRESSURE VESSEL OF A NUCLEAR REACTOR. Ronald Bellinger and Ernest James Hutchinson (to Strachan and Henshaw, Ltd.). British Patent 874,226. Aug. 2, 1961.

An apparatus is designed for handling radioactive materials during the charging and/or discharging of a reactor pressure vessel under pressure and while the reactor is being operated. The apparatus comprises a chamber adapted to be connected to the pressure vessel by a conduit, storage means in the chamber, externally operable transfer means within the chamber, and television cameras having a field of vision within the chamber. (D.L.C.)

26144 IMPROVEMENTS IN TUBULAR ELEMENTS FOR HEAT EXCHANGERS. Andre Huet. British Patent 874,395. Aug. 10, 1961.

A heat exchanger tubular element is designed with external fins corrugated in a variable manner over their length. The element is formed of several conjoined tube sections in which the heat exchange surface per unit of length is constant in each tube section but different from one tube section to the next. By aligning these tube sections in a suitable order, it is possible to attain any predetermined law of heat exchange from the inlet to the outlet of the heat exchanger. (D.L.C.)

26145 MANIPULATING APPARATUS FOR THE REMOTE HANDLING OF OBJECTS. Victor Boris Hessen (to Pye, Ltd.). British Patent 874,495. Aug. 10, 1961.

A manipulating apparatus is described which has foot-operated controls for controlling lateral and backward-forward movement of the slave arm and one or more television cameras. With this apparatus, the operator can remain seated and retain his hands on the grip controls while effecting slave arm movement and/or camera control. (D.L.C.)

26146 IMPROVEMENTS IN OR RELATING TO CLOSURE MEANS FOR PRESSURE VESSELS. Harry William Norton (to Geartyht Unions, Ltd.). British Patent 874,640. Aug. 10, 1961.

A self-locking closure means for pressure vessels is designed which incorporates cam engagements and which cannot be removed from the vessel until the pressure differential is relieved. (D.L.C.)

26147 IMPROVEMENTS IN ELECTRIC HEATERS. George Dickie Robertson and James Aitken Menzies (to Babcock and Wilcox, Ltd.). British Patent 874,757. Aug. 10, 1961.

An electric heater is designed for simulating gas-cooled reactor fuel elements. The heater comprises an electric resistive heating element in the form of ribbon wrapped helically against the interior surface of an aluminum alloy tube, with a film of anodized aluminum alloy or of aluminum oxide interposed between the element and tube. The cross section of the helical element may be varied along its length in order to vary the heat input to the tube. (D.L.C.)

26148 IMPROVEMENTS IN OR RELATING TO CABLE WINDING APPARATUS. Robert Tait and Albert Edward Wright (to United Kingdom Atomic Energy Authority). British Patent 874,837. Aug. 10, 1961.

A cable winding apparatus for electrical cables or fluid-conducting cables is designed which is particularly suitable for use with cable for a television camera to be lowered into a reactor fuel channel. The apparatus comprises a rotatable cable storage reel with the cable divided into two parts, one on the reel and the other off the reel. The playing-out of the cable proceeds in such a manner that twisting of the cable is avoided. (D.L.C.)

26149 IMPROVEMENTS IN OR RELATING TO METHODS AND APPARATUS FOR MELTING MATERIALS. Henley Frank Sterling (to Standard Telephones and Cables Ltd.). British Patent 875,592. Aug. 23, 1961.

An apparatus is devised for melting reactive materials and comprises a container of hollow copper or silver walls through which a cooling fluid is circulated. The material is melted in the container by r-f electric currents in the container walls. The apparatus is suitable for the decomposition of silane to silicon. (D.L.C.)

26150 IMPROVEMENTS IN OR RELATING TO LIFTING CABLES. Herbert Chilvers Knights and Ernest Edward Jerkins (to United Kingdom Atomic Energy Authority). British Patent 875,787. Aug. 23, 1961.

An improved form of composite lifting and operating cable is designed for a gas-operated grab. The cable comprises an assembly of two flexible tubes with a lifting wire between them to form a flat, coilable lay. (D.L.C.)

26151 IMPROVEMENTS RELATING TO PRESSURE VESSELS. Ronald James Hawkins (to Babcock and Wilcox Ltd.). British Patent 875,868. Aug. 23, 1961.

A pressure vessel for containment of hot fluids under pressure is designed with thermal insulation. The thermal insulation is sealed off from the air by covering panels which are arranged for accommodation of expansion or contraction of the pressure vessel. (D.L.C.)

26152 REMOTE CONTROL FOR MANIPULATORS. (to General Mills, Inc.). British Patent 875,906. Aug. 23, 1961.

A control unit is designed for regulating a multiplicity of bending, extending, and rotating movements of a remotely controlled handling unit. (D.L.C.)

26153 HYDRAULIC JOINT SEALING DEVICE. (to United Kingdom Atomic Energy Authority). French Patent 1,205,570. Feb. 3, 1960.

A hydraulic joint sealing device is offered. It has a channel inside the sealing part which is partly immersed in the liquid, said channel terminating on one side of the said sealing part below the liquid level and on the other side above this level. This sealing device serves preferably for joining the rotating top shield to the tank of a nuclear reactor. Suitably, two hydraulic joints are combined in series enclosing a gas space between them. (NPO)

26154 IMPROVEMENTS RELATING TO TIGHT VALVES. A. F. R. Peyron. French Patent 1,208,224. Feb. 22, 1960.

In order to avoid loss of fluid which may be radioactive or toxic, a valve able to control the circulation of this fluid comprises two bellows having different diameters and being coaxially arranged. One end of each bellows is in tight connection with the inner wall of the valve casing. The other ends of these bellows are connected with a movable piece. This movement is associated with a variation of the volume bounded by the wall of the valve casing, the two bellows and the said movable piece, so that this movement may be controlled by controlling the state of a control fluid occupying this volume. This movable piece supports the valve member that can be pressed against the valve seat. (NPO)

26155 METHOD FOR MANUFACTURING A CENTRIFUGE. (to Reactor Centrum Nederland). French Patent 1,210,792. Oct. 5, 1959.

A method is given for manufacturing tubular centrifuge bodies, comprising the impregnation of a cylindrical mat of glass fibers with a hardening liquid synthetic resin in a rotating mold. Pressure is exerted on the inner wall of the cylinder by means of an inflatable bag, and the mold is kept in rotation until the resin has set. (NPO)

26156 IMPROVEMENTS RELATING TO INDUSTRIAL FILTERS HAVING REPLACEABLE CARTRIDGES PREFERABLY FOR THE MICRO-FILTRATION OF FLUIDS USED IN NUCLEAR TECHNOLOGY. (to Commissariat à l'Énergie Atomique). French Patent 1,211,614. Mar. 17, 1960.

An industrial filter, preferably for the micro-filtration of fluids, used in nuclear technology, has filter cartridges arranged in an enclosed fluid-tight space preferably surrounded by a radiation shielding. The filter units take the

form of replaceable cartridges, each cartridge being constituted by a pile of filter elements arranged in series relative to the fluid stream. These filter elements are preferably made of sintered metal and take the form of a small plate or of a disc. (NPO)

26157 IMPROVEMENTS RELATING TO LOCKING DEVICES FOR COVERS OR PLUGS CLOSING A CONTAINER OR A METAL CASING. (to Commissariat à l'Énergie Atomique). French Patent 1,211,818. Mar. 18, 1960.

In order to place a cover or plug in position, to remove it and to lock it in position or unlock it, this cover or plug comprises an axial movable organ, via which the force inducing the positioning or removing of the cover or plug is transmitted. This organ, urged by the said force, is movable between two positions. In the first position, levers mounted pivotally in the cover or plug are pushed by said movable organ into a locking position; in the second position of the said movable organ these levers are pushed back and the cover or plug is unlocked. This second position is assumed by the said organ when it is pulled in order to remove the cover or plug. (NPO)

26158 FLUID TIGHT SAFETY VALVE. (to Commissariat à l'Énergie Atomique). French Patent 1,213,494. Apr. 1, 1960.

A fluid-tight safety valve has downstream from the valve seat and the closing disc a diaphragm sealing in a tight manner the fluid system in which radioactive or toxic fluid may be under pressure. If this pressure reaches a predetermined excessive value, this pressure controls the release of a spring actuated cylindrical tool that cuts out the diaphragm and thereby opens the valve by virtue of an axial movement of the closing disc, which is connected with the portion of the diaphragm that is cut out. The release of the cutting tool and the said axial opening movement is controlled by a bellows-operated lever system actuated by the working pressure in the fluid system. (NPO)

26159 NEW RAPIDLY OPENABLE CONTAINER FOR FILTER ELEMENTS. (to Société Indatom). French Patent 1,226,660. Feb. 29, 1960.

A filter for radioactive media is described which consists of a cylindrical tank in which an annular filter element is mounted. The tank is provided with an axial bottom inlet tube which leads the medium to the top of the filter element, and with a bottom outlet. The Pb lid of the tank can be easily removed. The filter is to be installed in some shielded space giving access from above, such as a pit. (NPO)

26160 ATOMIC PILE. (to Société Telefunken-France). French Patent 1,233,604. May 9, 1960.

A nuclear battery of very small dimensions is described, which consists of a combination of Sr^{90} and a luminescent material, e.g. in the form of a finely powdered mixture or of juxtaposed layers. The luminous energy is converted into electricity by means of one or more juxtaposed photoelectric cells. (NPO)

26161 ATOMIC BATTERY GIVING A HIGH TENSION. (to Société Telefunken-France). French Patent 1,233,663. May 9, 1960.

The battery consists of an evacuated container (gas pressure 10^{-2} to 10^{-4} mm Hg), in the center of which an emitting cathode, e.g. a nickel tube covered with $Sr^{90}(NO_3)_2$, is mounted. The collector is applied on the outside of the dielectric, e.g. polystyrene, wall of the container. A potential of 800 kV can be obtained. (NPO)

26162 ELECTRONIC CAPACITOR. (to Electro-Union S. A.). French Patent 1,236,016. June 7, 1960.

The battery consists of a cylindrical Ni core carrying a layer of radioactive material, e.g. $Sr^{90}(NO_3)_2$, a dielectric separating layer, e.g. consisting of polystyrene, and an outer metallic collector. A number of successive elements can be disposed concentrically around each other, thus increasing the capacity. (NPO)

Heat Transfer and Fluid Flow

26163 (ANL-6366) SOME HEAT TRANSFER AND FLUID FLOW CONSIDERATIONS FOR A PACKED-BED FUEL ELEMENT. R. Viskanta (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 45p.

The problem of heat transfer and fluid flow in a heat-generating porous media was studied analytically. The study was limited to the range of parameters of interest to the packed-bed fuel element concept. The available heat transfer and pressure drop correlations are reviewed. A system of partial differential equations which govern the velocity and temperature fields in an isotropic porous media was derived. Steady-state temperature distribution in a one-dimensional packed bed was studied, and a numerical method is presented for calculating transient temperature distributions. Pressure drop in a heat-generating packed bed was considered, and flow and temperature stabilities were examined. (auth)

26164 (ASTRA-417-5.0) THE HEATING PROGRAM (HEAT ENGINEERING AND TRANSFER IN NINE GEOMETRIES). R. R. Liguori and J. W. Stephenson (Astra, Inc., Raleigh, N. C.). Jan. 1, 1961. 58p.

The HEATING program is a generalized heat-conduction code written for the IBM 7090 computer. The program allows the reduction of the amount of input information required without loss in generality and with several advantages. The program proceeds without operator intervention, under the FORTRAN-MONITOR system, according to the input specifications until the problem is completed. (B.O.G.)

26165 (BAW-1159) GAS-SUSPENSION COOLANT PROJECT. Final Report. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Aug. 15, 1959. Changed from OFFICIAL USE ONLY May 15, 1960. Contract AT(30-1)-2316. 274p.

The gas-suspension heat transfer test system was successfully operated for a total of 135 hr. Fluid velocities, densities, pressures, and temperatures up to 250 ft per sec, 10 lb per ft^3, 140 psig, and 1100°F were obtained. 125 kw were removed from a 0.542 ID tube 12.5 ft long corresponding to a heat flux of 215,000 Btu/hr/ft^2. A heat transfer coefficient of 1500 Btu/hr/ft^2·°F was obtained with nitrogen–graphite mixtures. Helium–graphite suspension coefficients of 3000 Btu/hr/ft^2·°F were obtained. The heat transfer system was constructed entirely of conventional equipment. The experimental work performed demonstrates that the addition of a suspension of finely divided graphite in nitrogen or helium produces a coolant which has excellent heat transfer and heat transport capability without sacrificing the advantages of gas coolants. (W.L.H.)

26166 (CEA-1790) ETUDE EXPERIMENTALE DU TRANSFERT DE CHALEUR ET DES PERTES DE CHARGE AVEC L'HYDROGENE GAZEUX EN ECOULEMENT TURBULENT DANS UN TUBE ET DANS UN ESPACE ANNULAIRE. (Experimental Study of the Heat Transfer and of Pressure Losses with Gaseous Hydrogen in Turbulent Flow in a Tube and in an Annular Space). A. de La Harpe and P. Perroud (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble). 1961. 40p.

Three different dispositions are used: a tube (diameter 4 mm, length 320 mm) and two annular spaces (3 × 8.8 and 5 × 8.8 mm, length 260 mm). The tubes are of stainless steel and are heated by a 50 cycle alternating current. The Reynolds number varied from 4000 to 120,000, the wall temperature up to 700°C, and the exit-temperature up to 500°C. Heat flows of up to 170 W/cm^2 were observed. All the experimental results can be summed up by a correlation expression of the Colburn type $Nu = 0{,}020\ Re^{0.8}\ Pr^{0.4}$, as long as the physical properties of the gas are expressed at the film temperature $t_{0.3} = t_m + 0.3\ (t_p - t_m)$. A variation of the film temperature index with the ratio of the heated to the wetted perimeters is observed. The pressure loss coefficients measured are slightly higher than those calculated using von Kármán formula for smooth tubes. (auth)

26167 (CEA-1857) ETUDE SYSTEMATIQUE DE L'UTILISATION DE CHAMPS ELECTRIQUES POUR L'AMELIORATION DES ECHANGES THERMIQUES DANS DES LIQUIDES BOUILLANTS. (Systematic Study of the Use of Electrical Fields for Improving Heat Exchange in Boiling Liquids). L. Bochirol, E. Bonjour, R. Lagnier, J. Verdier, and L. Weil (France. Commissariat a l'Energie Atomique. Centre d'Études Nucléaires, Grenoble). 1961. 42p.

Note PCBT-20, Nov. 1960.

The effect of electric fields on the exchange coefficients and on the maximum dissipitative powers before calefaction are studied at the boiling point for liquids with various electrical properties (hexane, benzene, trichlorethylene, demineralized water, acetone, methyl-ethyl-ketone, etc.). The mechanism is given of the significant improvements obtained (multiplication by a factor of 2 to 10) in the natural convection zone by showing the role played by the dielectric properties of the liquids under study, and in the zone of nuclear boiling by analysis of the forces acting on the boiling nuclei. Some experimental results are given concerning measurements made under pressure until local boiling occurred; they show the possibility of some interesting applications of the method. (auth)

26168 (GEAP-3389) CHICAGO OPERATIONS OFFICE STEAM SEPARATION PROGRAM, FEBRUARY–MARCH 1960. Final Report. H. D. Ongman (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Contract AT(04-3)-189. 31p.

A program is described for free-surface steam-water separation at 600 psig. The investigation was conducted in support of the design for incorporation in the Experimental Boiling Water Reactor at 100 Mw thermal. Equipment is described and the test procedures are outlined along with operation. Resulting data are presented tabularly. (J.R.D.)

26169 (NAA-SR-Memo-6411) COMPARISON OF THERMAL EFFICIENCIES FOR A MERCURY–STEAM BINARY VAPOR CYCLE AND THE RANKINE CYCLE. L. L. Prem (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 19, 1961. 7p.

A comparison of the thermal efficiencies of the mercury–steam binary vapor cycle and the Rankine cycle shows that the binary cycle efficiency is greater. A temperature–entropy diagram and a schematic layout of the binary cycle are presented for clarity. (N.W.R.)

26170 (PIBAL-587) APPLICATION OF BIOT'S VARIATIONAL PRINCIPLE IN HEAT CONDUCTION. Thomas J. Lardner and Frederick V. Pohle (Brooklyn. Polytechnic Inst.). May 1961. Contract AF 49(638)-302. 105p. (AFOSR-932)

Biot's variational principle for heat conduction is applied to the solution of a number of one-dimensional problems. The applicability of the principle to problems involving prescribed heat flux boundary conditions and to problems with temperature-dependent material properties is illustrated. (auth)

26171 (NP-tr-702) HEAT TRANSFER AND THERMODYNAMIC MODELING. (Teploperedacha i Teplovoye Modelirovaniye). Translated from a publication of the Publishing House of the Academy of Science, Moscow, 1959. 554p.

Included is a collection of papers on the theory of similarity and thermodynamic model analysis of heat transfer. The papers discuss studies of: criterional values of the theory of the regular thermal regime of the second kind; theoretical foundations for electrical cable cluster design for shipboard use; thermal regime of electrical cable clusters for shipboard use; determining thermal conductivity of molten metals by successive steady states; thermal conductivity and specific weight of heavy water; heat transfer of metals flowing in tubes; calculation of heat transfer of liquid metals; hydraulic resistance of liquid metals flowing in tubes; effects of thermophysical properties of heat transfer agents on heat transmission in conditions of natural convection; mean heat transfer of fluids flowing in tubes; heat transfer of fluids flowing in annular and slit ducts; heat transfer by convection at high pressure; heat transfer in viscous flow of a liquid in tubes for substantial variations in viscosity; heat exchange in the initial section of a tube for mixed boundary layers; heat transfer of a cylinder in cross flow; heat transfer during fluid flow across tube banks; heat transfer in free motion; heat transfer of boiling water in forced convection; steam-content measurements in boiling with subcooling; determination of heat transfer coefficients for vapor condensation of viscous substances; heat transfer in steam condensation on vertical tubes; similarity conditions of molecular processes; generalization of experimental data on viscosity and heat conduction of steam; methods for calculating integral and local angle factors of thermal radiation; application of similarity theory to the analysis of radiation effects in furnaces and combustion chambers; and thermo-optical modeling of radiative heat transfer. (B.O.G.)

26172 MEASURED VARIATIONS IN LOCAL SURFACE TEMPERATURES IN POOL BOILING OF WATER. S. T. Hsu and F. W. Schmidt (Univ. of Wisconsin, Madison). J. Heat Transfer, 83: 254-60(Aug. 1961).

An investigation of the surface-temperature variation during nucleate pool boiling at atmospheric pressure was conducted. The effect of surface temperature, heat flux, and heating-surface material was investigated. The temperature variation of the surface was found by a specially fabricated thermocouple placed in contact with it. The average maximum temperature variation may be found from the following equation:

$$\Delta T_{avg\ max} = c[q(f/\alpha)^{1/4}]^{-a}\ \frac{q\Delta T_{sur-sat}}{k}$$

The exponent a is a function of surface roughness. The rate of heat flow was denoted by q in Btu/sq ft-hr, α the thermal diffusivity in sq ft/hr, f the frequency of variations in cphr, k the thermal conductivity in Btu/ft-hr-deg F, and $\Delta T_{sur-sat}$ the temperature difference between the heating surface and the saturation temperature of water. The coefficient c and exponent a were determined experimentally for various heating-surface materials and surface finishes. (auth)

26173 TWO-PHASE SLUG FLOW. Peter Griffith and Graham B. Wallis (Massachusetts Inst. of Tech., Cambridge). J. Heat Transfer, 83: 307-20(Aug. 1961).

Entrance effects can persist for great lengths, L/D = 300, and long times, in developing two phase flows. Wall shear stresses at moderate and low velocities contribute only slightly to the pressure drop in slug flows. Bubble-rise velocities in slug flow are quite sensitive to the velocity profile in the water ahead of the bubbles. The effect of wall shear stress manifests itself primarily through the velocity profiles. Pressure drop, density, slug length, bubble length and fluctuation pressure drops, and frequencies can be calculated for fully developed slug flow with good accuracy. (auth)

26174 DYNAMIC RESPONSE OF HEAT EXCHANGERS HAVING INTERNAL HEAT SOURCES. PART IV. W. J. Yang, J. A. Clark, and V. S. Arpaci (Univ. of Michigan, Ann Arbor). J. Heat Transfer, 83: 321-38(Aug. 1961).

The dynamic response of a heat exchanger having a sinusoidally time-dependent rate of internal heat generation was studied. Results for both the transient-periodic and the steady-periodic, or frequency response, are given. These results include the response of the wall and fluid temperatures and the wall-fluid temperature difference. A phenomena of resonance in the amplitude ratio and phase shift is disclosed. Analytical results are obtained through the use of the Laplace transform technique. Experimental results are presented which compare favorably with the theoretical analysis. Heat exchangers to which these results apply include the heterogeneous nuclear reactor. (auth)

26175 FILM-BOILING HEAT TRANSFER FROM A HORIZONTAL SURFACE. P. J. Berenson (Massachusetts Inst. of Tech., Cambridge). J. Heat Transfer, 83: 351-8 (Aug. 1961).

Taylor-Helmholtz Hydrodynamic Instability and its significance with regard to film boiling heat transfer from a horizontal surface is discussed. It is shown that near the minimum film-boiling heat flux, the bubble spacing and growth rate is determined by Taylor Instability neglecting the effect of fluid depth and viscosity. Utilizing a simplified geometrical model, an analytical expression for the heat-transfer coefficient near the minimum in film pool boiling from a horizontal surface was derived. Combining this equation with the available correlation for the minimum heat flux yields an analytical equation for the temperature difference at the minimum, which defines the location of the minimum point. The above equations agree with the available experimental measurements made on n-pentane and carbon tetrachloride within ±10 per cent. (auth)

26176 OSCILLATIONS IN TWO-PHASE FLOW SYSTEMS. G. B. Wallis and J. H. Heasley (Westinghouse Electric Corp., Pittsburgh). J. Heat Transfer, 83: 363-9 (Aug. 1961).

A mathematical analysis is given of three modes of oscillation of a simple two-phase flow, natural-circulation system, together with qualitative results of experiments with a small-scale loop model. (auth)

26177 FILM BOILING IN A FORCED-CONVECTION BOUNDARY-LAYER FLOW. R. D. Cess (Westinghouse Electric Corp., Pittsburgh) and E. M. Sparrow. J. Heat Transfer, 83: 370-6(Aug. 1961).

An analysis has been made to determine the heat transfer and friction characteristics in forced-convection film boiling on a flat plate. It is shown that the resulting two-phase flow problem can be formulated exactly within the framework of laminar boundary-layer theory. Solutions covering the parameter range of practical interest have been obtained by a combination analytical-numerical method. Heat-transfer and skin-friction results are presented both graphically and as simple, closed form analytical expressions. Relative to the case of pure liquid flow, the skin friction is substantially reduced due to film boiling. The heat transfer is found to increase as $(\Delta T)^{1/4}$, a much smaller dependence than in other convection phenomena. (auth)

26178 SUBCOOLED FORCED-CONVECTION FILM BOILING ON A FLAT PLATE. R. D. Cess (Westinghouse Electric Corp., Pittsburgh) and E. M. Sparrow. J. Heat Transfer, 83: 377-9(Aug. 1961).

An exact boundary-layer formulation was used to provide results, for liquids of all Prandtl numbers, on subcooled forced-convection film boiling on a flat plate. (L.T.W.)

26179 FLOW VISUALIZATION AND VELOCITY MEASUREMENT IN NATURAL CONVECTION WITH THE TELLURIUM DYE METHOD. R. Eichhorn (Univ. of Minnesota, Minneapolis). J. Heat Transfer, 83: 379-81(Aug. 1961).

It has been demonstrated that the tellurium dye trace method of qualitatively and quantitatively studying flows of water as developed by Wortman for use in forced convection is equally suited for use in free-convection flows and is possibly superior to other means presently employed for that purpose. In addition, this technique is simple enough in application so that it can be developed as a teaching aid in undergraduate laboratory instruction. (auth)

26180 EXPERIMENTAL INVESTIGATION OF A FEW PROBLEMS ARISING IN ONCE-THROUGH FORCED-CIRCULATION STEAM GENERATORS OPERATING AT SUPERCRITICAL PRESSURES. J. Kägi. Sulzer Tech. Rev., 43: No. 1, 29-36(1961).

Investigations conducted into the deposition of salts in tube systems under supercritical steam conditions yielded results which were not expected from the experience acquired under subcritical conditions. Some of the results relating to the location and intensity of deposition for various salts are quoted. Salts are deposited even when the salt concentration in the feedwater is far below the maximum solubility level under the mean steam conditions prevailing in the tube. The deposits remain stable only at certain temperatures. A lowering of the temperature by an amount which depends on the nature of the salts will cause existing deposits to vanish completely in a relatively short time. Where mixtures of salts are present, some components may have a marked effect on the intensity of deposition of others. Of the various alkalizing agents investigated, ammonia alone is stable at 650°C. (auth)

26181 TUBE SUPPORTS FOR HEAT EXCHANGERS OR SIMILAR EQUIPMENT. (to Société Grenobloise d'Études et d'Applications Hydrauliques (SOGREAH)). French Patent 1,217,691. May 5, 1960.

In a heat exchanger comprising a bundle of parallelly arranged tubes the proper relative position of the tubes is secured by tube supports. These supports are constituted by tubular pieces mounted on these tubes and held in place by shrinking or welding and having a plurality of branches with their extremities resting on the adjoining tubes. Preferably one tube in three has a support mounted on it. The said support may be of constant cross section (e.g. extruded) and constituted by three semicircular branches connected together by three cylindrical elements centered on the said heat exchanger tube. (NPO)

26182 HEAT EXCHANGER WITH ADJACENT FLUID PREFERABLY FOR THE COOLING OF URANIUM HEXAFLUORIDE. (to Société Générale de Constructions Élec-

triques and Mécaniques (ALSTHOM)). French Patent 1,221,850. June 3, 1960.

For the cooling of uranium hexafluoride in a heat exchange system a second adjacent fluid is used. This fluid is at its boiling point in a heat exchanger and in this way cools the uranium hexafluoride and is then condensed in a further heat exchanger, being cooled therein by a third fluid. The said second fluid, preferably constituted by freon, travels by natural circulation through the closed circuit. (NPO)

26183 HEAT EXCHANGER. (to United Kingdom Atomic Energy Authority). French Patent 1,224,926. June 28, 1960.

A heat exchanger, preferably for a gas cooled nuclear reactor, has a vessel so constructed that the hot gas enters it by an entrance tube preferably at the bottom and leaves it by preferably lateral exit tubes fitted near the top. The said vessel may be cylindrical with its axis vertical and enclose a tube system through which boiling water circulates. This tube system has vertical header pipes extended by entrance and exit tubes mounted in the cover of the vessel. Between the cylindrical vessel wall and the said tube system a further cylindrical casing is arranged, closed at the bottom and forming an interspace in which water circulates, cooling the wall of the vessel, so that this latter system may be used as economizer. The said interspace is separated at the top from the remaining space enclosed by the vessel. The entrance for this interspace is preferably near the bottom, the exit near the gas exits of the vessel. (NPO)

Instrumentation

26184 (AD-129238) GROUND ZERO LOCATORS. Research Report, High Polymer Series No. 7. J. D. Loconti, H. W. Coles, and C. D. Thron (Quartermaster Research and Development Center, Natick, Mass.). Nov. 1, 1956. 15p.

A simple, low-cost device for locating the ground zero of atomic explosions was designed which has good accuracy and a sensitivity range of 5 to 10 miles from the zero point. The device consists of a foamed polystyrene sphere with three coatings (base contrast coating, thermosensitive coating, and weather-protective top coating) mounted on a secure metal rod and provided with discs above and below to shield it from solar radiation and from nuclear radiation reflected from the ground. (D.L.C.)

26185 (AFSWC-TN-61-4) SOME RECENT DEVELOPMENTS IN RADIOPHOTOLUMINESCENT DOSIMETRY, INCLUDING TEST RESULTS. William C. Bryan and William P. Schaus (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Dec. 1960. 68p.

Efforts to improve dosimetry in use by the U. S. Air Force and the U. S. Navy resulted in the development of a new Navy-sponsored model of the Detector, Radiac DT-60/PD, and an experimental Air Force modification of the Computer-Indicator, CP-95A/PD. In addition, some refinements were adopted in the calibration procedures associated with this dosimetry system. The results of testing the new dosimeter and the modification of the computer-indicator at the Air Force Special Weapons Center are reported and the calibration procedures are discussed. Some comments are made on the compatibility of old and new models of the dosimeter with the CP-95A/PD and on continuing developments. The new DT-60/PD is considered suitable in a nuclear warfare situation if certain limitations, such as the effects of certain extreme environmental conditions and their limited utility for measuring small doses, are recognized. (auth)

26186 (BMI-X-175) DEVELOPMENT OF MINIATURE HEATING ELEMENTS FOR A POWER-BALANCING TYPE THERMAL-FLUX SENSOR. D. R. Grieser (Battelle Memorial Inst., Columbus, Ohio). Aug. 14, 1961. 9p.

Miniature heating elements were developed and tested for long-life performance at 1500°F and under thermal cycling and neutron irradiation conditions. The pyrolytic carbon film heater and the oxide-insulated, closely wound Chromel-A heater were found to exceed the performance requirements. (D.L.C.)

26187 (BNL-5618) 5 KILOVOLT, 1.25 KILOWATT CAPACITOR CHARGING SUPPLY. D. M. Miller (Brookhaven National Lab., Upton, N. Y.). Apr. 1961. 10p. (IHR-102)

Design of the circuitry for a 5000-volt supply for charging capacitors to be used with a beam ejection magnet at the AGS is descirbed. (J.R.D.)

26188 (BNL-5621) 4 kv POWER SUPPLY. D. M. Miller (Brookhaven National Lab., Upton, N. Y.). Apr. 1961. 7p. (IHR-105).

A rack-mounted high-voltage (0 to 4 kv) capacitor-charging supply for use in bubble chamber experiments is described. (D.L.C.)

26189 (BNL-5622) DROP COUNTER. S. C. Goscinski (Brookhaven National Lab., Upton, N. Y.). June 26, 1961. 22p. (IHR-106)

An operational and technical guide for the use of a liquid drop counter is presented. The system operates on the principle of light beam interruption which activates a photodiode detector. (J.R.D.)

26190 (BNL-5623) RANDOM NOTES ON HPD FRAME IDENTIFICATION PROBLEM. PART I. THE D DIFFERENCE PROBLEM. R. M. Sugarman (Brookhaven National Lab., Upton, N. Y.). July 3, 1961. 6p. (IHR-107)

The problem of identifying the frames of HPD microfilms by means of the D difference is treated. Readout of films is discussed. (D.L.C.)

26191 (BNL-5624) RANDOM NOTE NO. 2 OF HPD FRAME IDENTIFICATION BASED ON NOTE NO. 1 AND G-8 PROPOSAL OF PAUL. Robert Sugarman (Brookhaven National Lab., Upton, N. Y.). July 6, 1961. 4p. (IHR-108)

Comments are made on several proposals for the modification of the readout system for HPD microfilm frame identification. (D.L.C.)

26192 (CEA-1506) PERFECTIONNEMENTS DANS LA DOSIMETRIE INDIVIDUELLE PAR EMULSION PHOTOGRAPHIQUE. (Perfection of the Individual Photographic Emulsion Dosimeter). G. Soudain (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1960. 7p.

A photographic dosimeter making possible the measurement of γ radiation doses of from 10 mr to 800 r by means of 3 emulsion bands of varying sensitivity is described. The dosimeter has also a zone for marking and a test film insensitive to radiation. This zone requires a photometric measurement by diffuse reflection and makes it possible to measure doses with an accuracy of 20%. (auth)

26193 (CEA-1930) ETUDE SUR MAQUETTE DE L'HOMOGENEITE DE LA DETENTE DANS LA CHAMBRE A BULLES. (A Study of Models of the Inhomogeneity of the Decompression in a Bubble Chamber). J. Badier (France. Commissariat a l'Energie Atomique, Centre d'Etudes Nucleaires, Saclay). 1961. 10p.

A model was constructed for determining the shape of a hydrogen bubble chamber which gives a maximum of homo-

geneous decompression with no vortices. Air was used in the model, but actual conditions were simulated by varying the piston speed. The model was placed at one end of a tunnel, and compression-decompression waves were produced at the other end. The results indicate that the chamber base should be made round and that 5, not 3, fins should be used in the space between the decompression cylinder and the chamber body. (D.L.C.)

26194 (CF-61-5-109(Suppl.1)) CALIBRATION OF IONIZATION GAUGES IN A MAGNETIC FIELD. C. E. Normand (Oak Ridge National Lab., Tenn.). June 19, 1961. 8p.

The results obtained in a series of calibrations of ionization type vacuum gages operating in a magnetic field are summarized. Two gages are of the Byard-Alpert type (RG-75 and 7169) and differ primarily in dimensions of the tube elements and in filament structure. The other gage is of the type (VG-1A) where the collector surrounds the grid and filament. The calibration factor is obtained by comparing the pressure increment with the observed gage response. This method is used when the vacuum gage is calibrated against a series of known pressures derived from the measured rate at which gas is introduced to a test chamber, and the theoretical speed of pumping from the chamber through a fixed orifice is known. (N.W.R.)

26195 (CNEN-60) A GENERAL SURVEY OF HIGH SPEED PHOTOGRAPHIC TECHNIQUES. G. H. Lunn (Italy. Comitato Nazionale per le Ricerche Nucleari. Frascati Laboratori). Feb. 1961. 25p.

The survey includes information on still cameras which take a single picture and cine cameras which take a chronological series of pictures. It is noted that a number of still cameras can be arranged to operate as cine. It is concluded that the techniques which appear to offer the greatest possibilities are those associated with photo-emissive effects, preferably with direct detection of the photo-electrons, which provide higher time resolution and signal amplification. (J.R.D.)

26196 (CNI-78) THE TRANSISTOR COUNTING CHAIN OF ISPRA. G. Giannelli, V. Mandl, and L. Stanchi (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). Apr. 1961. 27p.

A set of transistor circuits for nuclear physics measurements in the microsecond range is described. These circuits are a pulse amplifier, a Schmitt discriminator, a coincidence circuit, a linear gate, two scalers, a printing unit, a timer, a linear count ratemeter, and a high voltage supply. The basic operating principles of circuits and general use techniques of transistors are discussed. (auth)

26197 (JINR-P-131) ORGANICHESKIE PLENOCHNYE STSINTILLYATORY. (Organic Film Scintillators). L. Ya. Zhil'tsova and M. N. Medvedev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1957. 11p.

Preparations of 0.03 to 0.5 mm thick organic film scintillators are described. The film scintillator pulse amplitudes are about 50% of the stilbene pulse amplitude and do not depend on the luminescence filler. The film is not sensitive to γ rays and is capable of 100% recording of strong ionizing radiation. (R.V.J.)

26198 (JINR-P-303) RABOTA PUZYR'KOVOI KAMERY, NAPOLNENNOI SMES'YU DVUKH ZHIDKOSTEI. (Performance of Bubble Chamber Filled with Two-Liquid Mixture). D. Nyagu and R. G. Salukvadze (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 16p.

The performance of a bubble chamber filled with a mixture of methyl iodide and propane is analyzed, and the results of measurements of various physical magnitudes characterizing the system are quoted. Certain aspects conducive to more efficient performance of a two-component bubble chamber are suggested. (R.V.J.)

26199 (M-6111) LEAKAGE CURRENT OF TANTALUM CAPACITORS. C. B. Pearlston, Jr. (Sandia Corp., Albuquerque, N. Mex.). Jan. 25, 1956. 24p. (SCTM-15-56-14-A)

The effects of long-term storage at high, low, and room ambient temperatures on the leakage current of sintered anode tantalum capacitors were studied. To investigate these effects, 86 units were tested. The test data were plotted on semi-logarithmic graph paper and approximated a logarithmic relationship between leakage current and time in storage. The value of prolonged conditioning of the capacitors prior to storage was shown to be of doubtful efficacy and is not recommended as a means of reducing leakage current. It is, however, recommended that the units be conditioned at periodic intervals to insure proper functioning. (M.C.G.)

26200 (ORNL-3098) THE DEVELOPMENT OF A DIRECT COUPLED, TRANSISTORIZED, SUB-MILLIMICROAMPERE CURRENT AMPLIFIER. F. T. May (Oak Ridge National Lab., Tenn.). Aug. 11, 1961. Contract W-7405-eng-26. 118p.

Development of a direct coupled, transistorized current amplifier is reported with sensitivities extending below the millimicroampere region of input currents. The amplifier employs a shunt feedback and exhibits reproducible characteristics. Discovery of this special effect and the design and testing employed in the incorporation of transistors into the amplifier are described. (J.R.D.)

26201 (SCTM-175-61(73)) X-RAY, MOTION-PICTURE PHOTOGRAPHY AS A TOOL IN VIBRATION ANALYSIS. D. Williams, Jr. (Sandia Corp., Albuquerque, N. Mex.). July 1961. 9p.

A description is given of a proposed x-ray motion-picture system to be used with a vibration table. It is designed to obtain a picture of the performance of equipment inside hermetically sealed containers. (auth)

26202 (TID-13359) THE CHANNELED IMAGE INTENSIFIER. Eleventh Quarterly Report, January through March 1961. (Chicago. Univ. Labs. for Applied Science). Contract AT(11-1)-647. 21p.

The development of a 5-mesh channeled image intensifier is described. Efforts were made to achieve limited production of 5-mesh tubes, and a demountable design with an all-metal, bakeable high-vacuum seal was adapted. However, actual production of the tubes was delayed by leaks in the high-vacuum connectors, which appear to be due to faulty design and construction of the flanges. (D.L.C.)

26203 (UCRL-9720) A MULTIPLEX PULSE-HEIGHT RECORDER AND ANALYZER. A. A. Wydler (California. Univ., Berkeley. Lawrence Radiation Lab.). May 26, 1961. Contract W-7405-eng-48. 19p.

A system intended for the analysis, processing, and storage of pulse-height and time data originating from chemically prepared samples is described. This system can record the pulse height and time of an event received from one to six detectors. Included is a device to assist in the reading and evaluation of the recorded data. The system is such that input signals are coded, mixed in a passive network, and fed to a common pulse analyzer of the height-to-time-converter type. The output of the pulse-height analyzer is arranged to provide immediate visual indication on

a ten-by-ten register matrix, and permanent storage on a paper tape that has been previously identified by the originating input signal. Each entry on the paper tape includes the time of entry. (auth)

26204 (USNRDL-TR-521) GAIN-SHIFT VERSUS COUNTING RATE IN CERTAIN MULTIPLIER PHOTOTUBES. D. F. Covell and B. A. Euler (Naval Radiological Defense Lab., San Francisco). June 8, 1961. 17p.

Multiplier phototubes used in scintillation counting show shifts in gain when subjected to high counting rates. The nature of these shifts varies significantly from tube to tube. The gain shift characteristic of certain phototubes was examined to establish a basis for selecting quality phototubes for use in gamma-ray scintillation spectrometry. Of the representative samples of Dumont, RCA, EMI, and CBS phototubes evaluated, the EMI phototubes displayed the highest gain stability. (auth)

26205 (WT-1737) TEST RESULTS FROM AUTOMATIC YIELD INDICATORS. M. Cowan, Jr., D. N. Munro, and H. H. Sander (Sandia Corp., Albuquerque, N. Mex.). Oct. 1960. 43p. (OPERATION HARDTACK—Project 43.10).

Automatic yield indicators which operate on the negative-phase duration principle were developed. Details of their construction and results of field tests on nuclear events are given. Under temperature lapse conditions at the Pacific Proving Grounds, yield estimates were obtained during Hardtack Phase I for five detonations at distances ranging from 11 to 25 miles. The greatest error in yield was obtained at 22.5 miles where the ratio of indicated yield to actual yield was about 2.5. For a lapse condition, it is estimated that automatic yield indicators will nearly always indicate within a factor of 2 or 3 of the actual yield within the range to 0.1 psi peak overpressure (about 30 miles for 1 mt). Under strong low-level temperature inversions (rapid increase in temperature with increase in height above the surface) at Nevada Test Site, automatic yield indicators functioned properly on 11 shots on Operation Hardtack, Phase II. Yields ranged from 0.62 ton to 6.5 kt and distances ranged from 2 to 13 miles. On eight of these events, indicated yields were within a factor of 2 of actual yields. Greater errors on the three other events were caused by interference effects resulting from the inversion conditions. This and other blast-wave measurements indicate that factor-of-2 yield estimates can be obtained by the AYI about 70 per cent of the time under strong inversion conditions within the range of 0.1 psi. (auth)

26206 (Y-1358) DEVELOPMENT AND APPLICATION OF THE OXIDOMETER. J. B. Mankin, Jr. (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). July 14, 1961. Contract W-7405-eng-26. 21p.

A portable, transistorized field instrument, called an oxidometer, was developed to ascertain the relative quality of lubricating oils. Its operation is based on the principle that the dielectric constant of a hydrocarbon material increases with the degree of deterioration. The instrument was designed to test oils with initial dielectric constants from 2.18 to 2.24. This range includes a large number of lubricating oils in general plant use. Modifications are under consideration to extend the range to cover a wider selection of lubricating oils. (auth)

26207 (AEC-tr-4482(p.59-72)) THE SCINTI-SCANNER. Y. Tachibana, A. Suematsu, H. Ueyanagi, and S. Nakanishi.

A scinti-scanner was developed to automatically and directly measure the distribution of I^{131} in the thyroid gland. The device consists of a scintillation counter, photomultiplier, pre-amplifier, scaler, recording circuit, high-voltage supply, stabilized power unit, discharge electrode, recording paper, driving system, and control circuit. The approximation of the solid angle spanned by the aperture of the scintillator and the point source is described. Measurements were made of the relative yields with respect to the distance from the axis of the collimator to the source. Experiments were performed to investigate the effects of the counting rate and the distance from the collimator to the plane of the source. Scanning speed was determined. (M.C.G.)

26208 (AEC-tr-4482(p.73-82)) DESIGN OF A BETA-RAY TRANSMISSION-TYPE THICKNESS GAUGE. I. Tajima and H. Ishizuka.

The design of a thickness gage employing beta radiation is described. Stability over a long period of time, mechanical rigidity of the parts, non-susceptibility to temperature and humidity, ease of handling, adequate shielding, and low cost were considered. The gage consists of a detecting head, amplifier, signal, recorder, source, setter, and high voltage and power supply. The effects of temperature on the gage and methods of temperature compensation are discussed. The effects of the scattered beam on the reading of the thickness was determined. The range and precision of measurements with this gage are given. (M.C.G.)

26209 (AEC-tr-4482(p.83-9)) SUBTRACTION-TYPE THICKNESS GAUGE. H. Miwa, Y. Nishimura, and S. Umeda.

A subtraction-type thickness gage using transmission of beta radiation was developed to measure the thickness of asphalt which is set between two layers of tarpaulin paper. The principles of operation of this type of gage are discussed. A block diagram and a picture of the apparatus are presented. The gage can be used as a detector for the automatic mechanism controlling the thickness. (M.C.G.)

26210 (AEC-tr-4482(p.90-5)) MEASUREMENTS OF THICKNESS BY USING GAMMA-RAYS. H. Fukatsu and S. Makino.

The characteristics and mechanisms of a thickness gage using gamma radiation for measurement of iron sheets of about 50 mm during rolling are described. The most suitable source was found to be Cs^{137}. Amplifying and indicator circuits are given. The accuracy of the instrument was found to be good. (M.C.G.)

26211 (AEC-tr-4482(p.96-113)) BREMSSTRAHLUNG AS A RADIATION SOURCE FOR THE THICKNESS GAUGE. T. Oshida, H. Miwa, and M. Shimizu.

Experiments were carried out to investigate the character of the bremsstrahlung of the beta particle as a radiation source for the thickness gage. The Sr^{90}-Y^{90} source was used. An ionization chamber was used as a detector. The total ionization current due to the radiations, the ionization current due to one radiation, and the absorption coefficient were measured. Lead, copper, and aluminum were used as the targets. It was found that the absorption coefficient can be changed widely by choosing appropriate targets and the energy of the beta radiation. (M.C.G.)

26212 (AEC-tr-4482(p.114-31)) NECESSARY AMOUNT OF Co^{60} FOR HORIZONTAL PENETRATION GAMMA-RAY LEVEL GAUGE. S. Suma and T. Sumi.

A method was developed for determining the smallest quantity of Co^{60} required for the horizontal transmission-type gamma level gage. A statistical procedure was used to obtain this source quantity under certain conditions. The validity of this procedure was checked by experiments. The range of statistical fluctuations of the counting rate, the counting efficiency of the detector, the characteristics of

the circuit, the factors which determine the diameter and wall thickness of the tank, and the half-life of the isotope determine the minimum quantity of the isotope that can be used. (M.C.G.)

26213 (AEC-tr-4482(p.132-41)) TRIAL PRODUCTION OF INSTRUMENTS FOR MEASURING THE QUANTITY OF TOBACCO AND FUSE POWDER BY RADIATION. H. Watanabe, S. Suzuki, Y. Nishimura, S. Umeda, and T. Ando.

A thickness gage with two detectors for use in measuring quantities of tobacco and fuse powder is described. The output of the radiation detector depends on the deviation of the material from the standard value and is given in the form of an electric current. Two radiation detectors which have identical characteristics are used. For one of the detectors a standard sample is used. The machine is adjusted so that there is no difference in the outputs of the two detectors when the materials measured are the same as the standard. (M.C.G.)

26214 (AEC-tr-4482(p.142-9)) LEVEL GAUGE FOR POWDERY MATERIAL. Y. Nishimura and T. Ando.

A level gage for powdery materials was developed. The upper and lower boundaries of the powder were detected by a radiation source and two detectors which operated a controlling system and an alarm. The radiation source was in a container made of steel and lead. Geiger-Mueller tubes were used as detectors. The sensitivity of the detection was found to depend on the load resistance, the high voltage, and the intensity of the radiation. (M.C.G.)

26215 (AEC-tr-4482(p.494-507)) TRIAL PRODUCTION OF CHARTS FOR TESTING RESOLVING POWER OF EMULSION FOR AUTORADIOGRAPHY. S. Oka, T. Mukaibo, S. Suzuki, and K. Yamada.

Trial production of charts for testing the resolving power of emulsions is described. The definition of resolving power in autography and the ambiguity in methods of measurement are discussed. By using the method adopted by Stevens, the original was made of the chart, which has 20 to 100 lines/mm or 40 to 200 lines/mm, by the reduced scale photograph on film of ultra-small particles. By using one of three methods of sulfurization, the silver part of the original chart was changed to Ag_2S^{35}. Using the charts produced by this process, the resolving powers of actual emulsions were determined. It was found to be possible to check the resolving power up to 200 lines/mm. To prepare a chart for P^{32}, the chart of Ag_2S was made as before but using non-radioactive sulfur. The chart was then exposed to a neutron beam and the S^{32} present converted to P^{32}. (M.C.G.)

26216 (AEC-tr-4482(p.508-19)) SCINTILLATION SPECTROMETERS WITH TWO AND THREE CRYSTALS. S. Shimazu, N. Neyanagi, H. Kanai, and K. Hosoi.

The energy of radiation was studied with a scintillation counter in the following cases: Compton coincidence spectrometry, which is applied to the precise analysis of gamma radiation with two crystals; pair spectrometry, which applies to the pair creation effect; and energy analysis of the fast neutron by using two crystals and measuring the recoil protons. The experimental apparatus consisted of two parts. One of these was the detector, which was suitable for all three kinds of spectrometry and involved the collimeter, the fixed table for detector supporting, and the detector. The other was the associated electronic circuit constructed of the following: detector, distribution amplifier, coincidence counting circuit, proportional amplifier, single-channel pulse-height analyzer, precise counter, electronic tube-type automatic balance recorder, variable delayed coincidence circuit, pulse generator for correction, and stable high-voltage electric source for the photomultiplier. The characteristics of each part of the apparatus are described. (M.C.G.)

26217 (AEC-tr-4482(p.682-93)) A STUDY OF MEASUREMENT METHODS FOR RADIOACTIVE DUST. S. Mikoshi, H. Sakabe, and T. Suzuki.

A large-capacity electrostatic dust collector which can be used to contribute data on the quantitative analysis of dust particles in industrial environments is described. Its application to the determination of radioactive dust particles in the atmosphere is discussed. The capacity of suction required for determination of activity was determined by the maximum permissible dosage to human beings of the substance concerned. An a-c type dust collector tube was constructed of hard glass. A flowmeter was designed to integrate the flow of 100 liters per minute. The circuit designed to shut the device off automatically after drawing 50 m^3 of air is shown. The efficiency of the collector was calculated. Curves were obtained to estimate the amount of substances with long half-lives without the influence of the presence of radon and thoron. (M.C.G.)

26218 (AEC-tr-4482(p.996-1004)) ON CLINICAL APPLICATION OF BACKGROUND ELIMINATING SCINTILLOGRAM PLOTTING TRIAL APPARATUS. T. Miyakawa, H. O. Edo, T. H. Tsujiya, E. R. Masuyama, T. H. Oda, M. O. Terada, and K. O. Temizu.

A background eliminating scintigram plotting apparatus was developed and compared with a conventional scintigram for clinical applications. First the pulse was divided into 10 channels. As a means of stretching, a monostable multivibrator was employed. It was connected, in turn, to a coincidence circuit and level clipping circuit. The signal from one level clipping circuit was the recording signal and this was amplified and connected to the light source. As the light source, an 8V miniature electric bulb was used. This new method was used to get a scintigram of a thyroid tumor patient to whom 150 to 300 μc of I^{131} were administered. Better results were obtained than with the conventional method. (M.C.G.)

26219 (AEC-tr-4482(p.1275-94)) ON METHODS OF MEDICAL MEASUREMENT OF RI. K. J. Fukatsu and S. O. Makino.

An extrapolation chamber was used to measure the depth dose of gamma radiation from Co^{60}. The structure and characteristics of the measurement apparatus are described. The requirements for equipment in radiation apparatus and the clinically necessary conditions are discussed. Measurements were also made of beta radiation from Sr^{90}. (M.C.G.)

26220 (AEC-tr-4568) LUMINESCENCE DOSIMETER BASED ON A $CaSO_4$.Mn PHOSPHOR FOR GAMMA-RAYS, BETA PARTICLES AND NEUTRONS. V. A. Arkhangel'skaya, B. I. Vainberg, V. M. Kodyukov, and T. K. Razumova. Translated from Atomnaya Energ. 8: 559-61(1960). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 19157.

26221 (GAT-Z-5025) DETERMINATION OF ECCENTRICITY IN X-RAY POWDER CAMERAS. E. C. Averbukh and S. S. Tolkachev. Translated by V. Langunoff for Goodyear Atomic Corp., from Uchenye Zapiski Leningrad. Gosudarst. Univ. im. A. A. Zhdanova, Ser. Khim. Nauk No. 15, 223-9(1957). 9p.

A method is derived for determining the eccentricity, the

misalignment of the axis of rotation of the cylindrical sample and the axis of the film cylinder in the x-ray powder camera. Eccentricity calculations are given for two diffraction patterns for tungsten. One pattern was obtained with no eccentricity, while the eccentricity of the second pattern was 0.71-mm perpendicular and 0.175-mm parallel to the beam. (B.O.G.)

26222 (JPRS-3231) SELECTED TRANSLATIONS ON ELECTRON MICROSCOPES. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 23; No. 4, 427-536(1959). 179p.

Included are papers on principal trends in electron microscopy, electron microscope-electronograph with an accelerating voltage of 400 kv, the UEMB-100 microscope with a double lens condenser, the UEMB-100 power supply, small electrostatic microscopes, a 75-kv electrostatic analyzer for electron velocities, measurement of fluorescent screen resolving power and light yield, compensation of axial astigmatism in lenses of multilens microscopes, ultramicrotome design, light-electron microscope using monocrystalline high resolution screens, x ray shadow microscope design, EM-5 microscope design, gaseous medium microscope chamber, electron gun design, power supply design, electron optical systems computer equipment, microscope shielding from external magnetic fields, EM-3 improvements, high-vacuum microscope design, microscope design for investigating thermo- and secondary emitters, and design of 100-kv electronograph. (J.R.D.)

26223 (JPRS-R-621-D) THE FIRST FOCALIZATION OF A PHOTOMULTIPLIER FOR COUNTING OF SCINTILLATIONS. G. Wendt. Translated from Ann. radioélec., No. 42, 372-86(Oct. 1955). 31p.

The requirements of a photomultiplier for scintillation counting are reviewed, and a study is made of photocathode-first dynode focusing. Examples of fully calculable field configurations show that minimum transit times can be obtained, either for the central or for the marginal trajectories. There exist therefore, between these extreme cases, focusing optics that enable very nearly equal transit times to be obtained for trajectories starting from any given point of the photoemissive layer. (auth)

26224 (SCL-T-373) STUDY OF THE PHOTODIELECTRIC PHENOMENON IN LUMINESCING ZINC CADMIUM SULPHIDES. (Studium der Photodielektrischen Erscheinung an Lumineszierenden Zinkkadmiumsulfiden). Ivan Soudek. Translated by Marcel I. Weinreich for Sandia Corp. from Czechoslov. J. Phys., 9: 590-6(1959). 11p.

The spectral interdependence of the photodielectric properties of the luminescing zinc cadmium sulfides of varying compositions shows that an admixture of Cu brings about the emergence of states with great polarizability, thus entailing a change in the real component of the dielectricity constants. The Cu concentration can be so slight that it does not exert any influence on the emission of luminescence. The infrared maxima of the losses correspond to the levels which have been ascertained also by other authors but with different methods. The maximum of the excitation spectrum within the range of the extension of the absorption margin is correlated with the maximum change of the real component of the dielectric constant. (auth)

26225 (SCL-T-375) CLOCKWORK FOR THE DISTRIBUTION OF ELECTRONIC CONTROLS. J. Chevallereau. Translated by Marcel I. Weinreich for Sandia Corp. from Recherche aeronaut., No. 76, 52-3(May-June, 1960). 5p.

The performance of a distributor of electronic controls governed by spring-operated clockwork and capable of functioning with perfect safety aboard experimental missiles is described. The characteristics and specifications of the clockwork are given. (M.C.G.)

26226 ENVIRONMENTAL PROBLEMS IN THE DESIGN OF SPACE POWER SYSTEMS. M. A. Zipkin (General Electric Co., Cincinnati). Aero/Space Eng., 20: No. 8, 14-15; 38-44(Aug. 1961).

The effects of the environmental problems in the design of space power systems for space vehicles are examined and discussed to show the effects they have on the thermodynamic cycle, materials, and system components such as the boiler, radiator, and rotating machinery. The environmental factors that are of concern to the space power plant designer are the atmosphere or the lack of an atmosphere, the external forces on the system, and the anticipated meteoroid population in space. The primary effect of the atmosphere and the meteoroid population is to force system temperatures to the highest attainable within metallurgical limitations. The principal effect of zero gravity is to require the development of boilers and condensers that rely on artificially created inertia forces which are large in relation to gravity. The influence on the design of a large (500 kw) closed-cycle nuclear turbogenerator power supply is illustrated employing the environmental factors. (N.W.R.)

26227 MONITORING IONIZATION CHAMBER FOR AN X-RAY GENERATOR. W. H. Henry and J. H. Aitken (National Research Council, Ottawa). Brit. J. Radiol., 34: 516-20(Aug. 1961).

The construction and operation of a monitoring ionization chamber are described. By its use, the delivery of successive x-ray exposure doses, normalized to the reading of the monitoring chamber, can be accomplished with a precision of better than 0.1%. An estimate is made of the effect of scattered radiation. (auth)

26228 GENERATOR OF ELECTRIC AND LIGHT PULSES IN THE NANOSECOND RANGE. Florin Tinta (Institut Polytehnique, Bucharest). Bul. inst. politeh. Bucureşti, 21: 165-76(Oct.-Dec., 1959). (In French)

The apparatus makes use of sparks between very close electrodes. The pulses have a serviceable duration of about 0.7×10^{-9} sec. and a rise time less than 10^{-10} sec. With the aid of an electronic forming circuit the duration of the pulses may be raised to 200 ns. One can vary the repetition rate from 30 to 6000 per sec. The measuring devices are described and the work possibilities are shown by getting resolution times of the order of 10^{-11} sec. This generator allows precise measurements of the time characteristics of photomultipliers and fast electronic circuits. (auth)

26229 A DEVICE FOR MEASURING VARIABLE MAGNETIC FIELDS. M. Ya. Mazurov. Byull. Izobret., No. 14, 27(1960).

The device contains a pancake measuring coil placed into the field being measured and an instrument that measures the voltage induced in the coil by the measured field. In order to reduce frequency measurement error, the model is provided with an integrating element consisting either of an induction coil or a capacitor series-connected with a resistance into the measuring coil circuit. (OTS)

26230 NON-BLOCKING LINEAR PULSE AMPLIFIER FOR SCINTILLATION AND PROPORTIONAL COUNTER. C. Rumler (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Ceskoslov. casopis pro fys., 11A: 226-41(1961). (In Czech)

The amplifier uses two delay lines when forming the pulses. During forming a bipolar pulse is produced so that

the zero axis is not displaced and thus there is no grid bias of the amplifying valves. The non-blocking property of the amplifier is proved by the measured gamma-spectra of the Cs^{137} radioisotope with a pulse counting rate of 2×10^5 pulse/sec. The amplitude nonblocking quality is documented by the pronounced X line of Ba^{137} having an energy of 32 kev in the presence of Co^{60}. (auth)

26231 THE USE OF AND EXPERIENCE GAINED WITH AN URS 50 I X-RAY DIFFRACTOMETER WITH GEIGER-MÜLLER COUNTER. S. Kadečková (Inst. of Physics, Czechoslovak Academy of Sciences, Prague). Československ. casopis pro fys., 11A: 242-56(1961). (In Czech)

A brief description is given of the URS 50 I x-ray diffractometer (USSR). The possibilities of its use for different x-ray structure measurements and some experiences gained with it are described. (auth)

26232 MEASUREMENT OF WEAK MAGNETIC FIELDS BY OPTICAL PUMPING METHODS. P. L. Bender (National Bureau of Standards, Washington, D. C.). Compt. rend. colloq. ampère, 9e colloq., Pise, 1960, p.621-8. (In English)

The design and performance of three types of magnetometers using optical pumping are described. A d-c alkali vapor, a self-oscillating alkali vapor, and a helium magnetometer are reviewed. (J.S.R.)

26233 A PARAMETRIC SPECTROGRAPH FOR MAGNETIC QUADRUPOLE RESONANCE. André Jelenski (Laboratoire d'Electronique et Radioélectricité de la Sorbonne, Fontenay-aux-Roses, France). Compt. rend. colloq. ampère, 9e colloq., Pise, 1960, p.649-55. (In French)

A parametric amplifier with variable capacity was designed for use as a magnetic resonance spectrograph. The properties, construction, and utilization of this amplifier are briefly described. (tr-auth)

26234 HELIUM IONIZATION CHAMBER USED AS A NEUTRON SPECTROMETER. I. Iori (Laboratori CISE, Segrate, Italy), G. Marcazzan, A. Marques, S. Menardi, and F. Tonolini. Energia nucleare (Milan), 8: 409-12 (June 1961). (In English)

A neutron spectrometer is designed, based on a method of analyzing the angle between a particle and the electric field in a gridded ionization chamber. The filling mixture is He + 30 to 40% Ar. The spectrometer is tested with 14 Mev neutrons; the energy resolution is 10% and the efficiency is $0.5\ 10^{-5}$/atm He. (auth)

26235 USE OF ENTRANCE HODOSCOPE FOR PARTICLE IDENTIFICATION IN VERY-HIGH-ENERGY BUBBLE CHAMBER EXPERIMENTS. W. Selove (Univ. of Pennsylvania, Philadelphia), H. Brody, E. Leboy, and R. Fullwood. IRE Trans. Nuclear Sci., NS-8: No. 3, 13-21(July 1961).

At energies of 10 Bev and higher it is difficult to obtain physically separated beams of π and K mesons. A hodoscope system which will register the identity of each of 20 particles entering a bubble chamber over a 100 microsecond time interval was constructed. Particles are localized by a scintillator hodoscope with matrix elements 1 cm square. Particle identity is determined with Čerenkov counters. The combined information is displayed on an oscilloscope and photographed at each bubble chamber expansion. (auth)

26236 THE LOG COUNT RATE PERIOD METER USED WITH SAFETY CIRCUITS. Helge Christensen (Royal Norwegian Council for Industrial and Scientific Research, [Oslo]) and Robert B. Stanfield. IRE Trans. Nuclear Sci., NS-8: No. 3, 22-6(July 1961).

Equations are presented that give the probable rate of spurious reactor scrams due to counter noise in the period circuits commonly used at low reactor power. It is shown how a filter introduced to reduce the spurious scram rate, will delay the circuit response in the case of true emergencies. A numerical example shows that a compromise can be reached that gives a very satisfactory circuit. (auth)

26237 EFFECT OF PRESSURE AND TEMPERATURE ON THE ABSORPTION SPECTRA OF FOUR ALKALI HALIDE PHOSPHORS. A. S. Balchan and H. G. Drickamer (Univ. of Illinois, Urbana). J. Chem. Phys., 35: 359-61(July 1961).

The effect of pressure and temperature was measured on the "A" bands in KI:Tl and in three alkali halides containing Pb^{2+} impurity. The effect of temperature is to impose a red shift on the observed room temperature pressure shift. The most remarkable result is the appearance of a new band in the high-pressure phase of KCl : Pb upon heating under pressure. The band remains after cooling, but disappears upon lowering the pressure into or through the region of the transformation back to the fcc phase. Repressuring and reheating reintroduces the band. The band is probably associated with the ionic configuration near the Pb^{2+} ion; especially with the location of the accompanying K^+ vacancy. (auth)

26238 TEST ROUTINES AND MONITORING FOR A LARGE COUNTER EXPERIMENT. Stanley C. Baker, Quentin A. Kerns, Frederick A. Kirsten, Dick A. Mack, and Thomas A. Nunamaker (Univ. of California, Berkeley). Nuclear Instr. & Methods, 12: 1-10(June 1961). (UCRL-9273) (In English)

Some recent multichannel scintillation-counter experiments are so complex that the use of test routines and fault monitoring becomes essential. In one experiment, it is desired to initially align the system, provide continuous calibration during the experiment, and rapidly locate the cause of threshold drift or catastrophic failure. A test and monitoring system is devised in which synthesized pulses are injected into several points of the system, and the operation is automatically compared with the desired response. If the system performance does not agree within prescribed limits, an alarm sounds. Through a program that varies the amplitude of the test signal, one can check coincidence-circuit threshold and feed-through characteristics. By programming delay between input pulses, the resolving time can be measured. Several monitoring devices are developed which allow one to assess the display of a large volume of information at a glance. One unit for reading time delays involves the use of a cathode-ray-tube raster display, another unit for reading binary information employs a transistor-driven incandescent lamp panel. (auth)

26239 AN ELECTRONIC DATA-ACQUISITION SYSTEM FOR USE WITH A COMPLEX NUCLEAR PHYSICS EXPERIMENT. Stanley C. Baker, Frederick A. Kirsten, Dick A. Mack, and Clyde Weigand (Univ. of California, Berkeley). Nuclear Instr. & Methods, 12: 11-19(June 1961). (UCRL-9271) (In English)

An electronic data-acquisition system is used with a nuclear physics experiment of such complexity that data processing required a high-speed computer. The system acquires data from 168 signal channels of scintillation counters and four channels of chronotron circuits. It has the capacity to store 10 events during the 0.1-sec-long Bevatron beam pulse. The storage time for the information from each event, consisting of 168 bits from the counters plus 12 bits from the chronotrons, is 40 μsec. In the interval between beam pulses, the stored information is punched onto paper tape in a form suitable for computer input. The

over-all characteristics and operation of the system are described. (auth)

26240 A TRANSISTOR COINCIDENCE-DISCRIMINATOR CIRCUIT FOR 10^{-8}-SECOND PULSES. Stanley C. Baker (Univ. of California, Berkeley). Nuclear Instr. & Methods, 12: 20-4(June 1961). (UCRL-9272(Rev.)) (In English)

A transistor coincidence-discriminator circuit of better than 10^{-8}-sec resolution and 0.25-V sensitivity is designed for use where large numbers of such circuits are required in a single system. The experience gained in operating 168 units in a physics experiment, and the methods developed for testing the sensitivity and resolution of the circuits during both initial checkout and operation in the experiment show the approach used to circuit design to be highly feasible. (auth)

26241 A SOLID-STATE CHRONOTRON FOR DIGITIZING TIME DELAYS. Arthur E. Bjerke, Quentin A. Kerns, and Thomas A. Nunamaker (Univ. of California, Berkeley). Nuclear Instr. & Methods, 12: 25-31(June 1961). (UCRL-9270) (In English)

This solid-state chronotron measures the relative time delay between two shaped photomultiplier pulses, and quantizes this time delay into seven time intervals with widths of 3 to 7 nsec. These intervals represent the difference in time of flight of two particles in a large scattering experiment, and may be varied at will by changing front panel cables. The quantized time delay is then stored in a buffer storage until readout, at which time the system is recycled. The time intervals are formed by splitting the two shaped photomultiplier signals into parallel diode coincidence circuits, with the time delay of each coincidence circuit set for the center of its respective time interval. Thus the coincidence circuit with the greatest output voltage indicates the correct time interval. To detect this voltage the stretched output of each coincidence circuit has a common ramp voltage added to it, and together these signals begin driving a bank of blocking oscillators. As soon as one blocking oscillator triggers, all others are disabled and the blocking oscillator that triggered sets up its binary coded number in the buffer storage. As the ramp generator always insures that one blocking oscillator triggers there is never a hole between time intervals because when one interval expands its neighbors will contract. Long-term stability of the time interval centers is a few tenths of a nanosecond, and the 24-hr stability of the edges of the intervals is ± 0.5 nsec. With the aid of a TV monitor used in checking the system, the chronotron can be held within the above limits indefinitely by simple daily adjustments. (auth)

26242 A TRIGGERED NANOSECOND LIGHT SOURCE. Quentin A. Kerns and Gerald C. Cox (Univ. of California, Berkeley). Nuclear Instr. & Methods 12: 32-8(June 1961). (UCRL-9269) (In English)

A nanosecond light source based on a corona discharge started by field emission was developed for attachment to scintillation counters. These individual light sources, placed to illuminate each phototube and fired by a pulse generator through splitting transformers and cable delays, have facilitated the coincidence timing of an array of photomultiplier detectors. Pulse generation, a pulse-splitting transformer, light-source construction, and timing properties, as well as spectral intensity are discussed. An optical attenuator designed for the source is described. (auth)

26243 AN 1800-BIT BUFFER STORE AND READOUT SYSTEM. Frank Evans and Frederick A. Kirsten (Univ. of California, Berkeley). Nuclear Instr. & Methods, 12: 39-42(June 1961). (UCRL-9274) (In English)

The logical design and organization of an 1800-bit buffer store for use with nuclear physics experiments is described. The heart of the system is an 1800-bit magnetic core memory, which stores up to 10 events, each event consisting of 180 parallel bits of input information. The storage time per cent is 40 μsec. Upon command the buffer store transfers the information out of the core memory, six parallel bits at a time, onto punched paper tape. The buffer store uses transistorized circuits of modular design, constructed on printed boards, and interconnected by taper-pin wiring. (auth)

26244 THICK JUNCTION RADIATION DETECTORS MADE BY ION DRIFT. Jack H. Elliott (Univ. of California, Berkeley). Nuclear Instr. & Methods, 12: 60-6(June 1961). (UCRL-9538) (In English)

Lithium-drifted detectors with depletion thicknesses up to 3.38 mm, capable of stopping 24-Mev protons and 96-Mev α particles, were produced. To the degree of accuracy of the experiment, the output pulse amplitude was linearly proportional to the energy absorbed in the detector, showing that the charge produced was collected with 100% efficiency. 47.6-Mev cyclotron-produced α particles were resolved to 0.9% full width at half-maximum. Most if not all of this width is attributed to beam energy spread. Details of production of these detectors are described. (auth)

26245 MTR PHASED CHOPPER VELOCITY SELECTOR. R. M. Brugger and J. E. Evans (Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Instr. & Methods, 12: 75-102(June 1961).

The Materials Testing Reactor (MTR) velocity selector consists of a pair of Fermi-type phased choppers and a pair of rotating collimators. The four rotors are driven at identical speeds up to 5225 rpm by four hysteresis synchronous motors. With the appropriate angular phase difference established between the choppers and the collimators, bursts of monoenergetic neutrons are selected from the MTR's Maxwellian flux. Phase instability broadens the initial neutron burst by only 12%, as demonstrated by actual measurements of time distributions. The monochromatic neutrons produced by the selector are used in measuring inelastic scattering cross sections by means of time-of-flight equipment. Intensities per time channel are sufficient to give reasonable statistics in a 24 hour run. Wavelength resolutions between 2% and 8% are realized. The layout and characteristics of the velocity selector are described, and the problems associated with backgrounds and time and intensity calibrations are discussed. Inelastic scattering data taken on samples of methane gas and on a beryllium single crystal are displayed and analyzed to show the counting rates and background levels achieved with the selector, and to demonstrate the versatility possessed by this type of monochromator. (auth)

26246 THE DESIGN OF BUNCHING MAGNETS. R. E. Holland (Argonne National Lab., Ill.). Nuclear Instr. & Methods, 12: 103-10(June 1961). (In English)

The design of a bunching magnet of the type suggested by Mobley and Van de Graaff is investigated. A relationship between the magnetic flux and the difference in length of the extreme paths is presented. The properties of a uniform-field sector magnet with fringing-field focusing are investigated. It is found that the divergence of the initial beam from an electrostatic accelerator could be expected to limit the maximum attainable bunching ratio (ratio of input acceptance time to output pulse width) when

sinusoidal deflection is used. A slightly more complex deflection system increased the maximum attainable bunching ratio. (auth)

26247 ALPHA PARTICLE THICKNESS GAUGE USING A SOLID STATE DETECTOR. Herbert L. Anderson (Univ. of Chicago). Nuclear Instr. & Methods, 12: 111-14(June 1961). (In English)

An alpha particle thickness gage is described in which the shift in energy of α-particles in passing through the material is observed directly by means of a solid state detector and pulse height analyzer. Measurements of the thickness of 1 mg/cm^2 foils can be made easily to better than 1%. The arrangement is useful for absolute energy loss measurements and some results are given for mylar. (auth)

26248 INTRINSIC LINE BROADENING IN NaI(Tl) GAMMA-RAY SPECTROMETERS. C. D. Zerby, A. Meyer, and R. B. Murray (Oak Ridge National Lab., Tenn.). Nuclear Instr. & Methods, 12: 115-23(June 1961). (In English)

The response of NaI(Tl) to gamma rays has indicated that the pulse height is not strictly proportional to the energy of the absorbed gamma. The nonproportional response to gammas implies a nonproportional response to electrons, which results in an intrinsic broadening of the full-energy peak in the pulse-height distribution from monoenergetic gamma rays. The magnitude of this effect is such that it results in a significant contribution to the total line width for scintillation crystals of typical dimensions. The results are based on Monte Carlo calculations using the nonproportional response of NaI(Tl) to electrons. Results of the calculations, applied to a 2.5-in. diameter by 2-in. high crystal, indicate a distinct broadening in the total absorption line in the case of Compton and pair-production events. The calculated fractional line width from this effect alone is negligible for energies below about 0.1 Mev and amounts to 2.6% at 0.15 Mev, 5.0% at 0.4 Mev, and 1.5% at 2.5 Mev. The dependence of this effect on the crystal size and source geometry is discussed. (auth)

26249 TRANSISTORIZED LINEAR GATE FOR PHOTOMULTIPLIER PULSES. F. F. Liu and F. J. Loeffler (Purdue Univ., Lafayette, Ind.). Nuclear Instr. & Methods, 12: 124-6(June 1961). (In English)

A temperature compensated, linear pulse gating circuit employing transistors is built which accepts pulses directly from the anode of photomultiplier tubes. Departures from linearity of less than 3% result for input pulses in the range 50 mv to 200 mv. (auth)

26250 UTILIZATION OF TUNNEL DIODES IN FAST TRIGGER CIRCUITS. Thomas A. Rabson (Rice Univ., Houston, Tex.). Nuclear Instr. & Methods, 12: 127-30 (June 1961). (In English)

A basic trigger circuit is described which utilizes tunnel diodes in their switching mode. An important feature of this circuit is its fast switching and reset times (10^{-9} sec). Applications of this basic circuit to pulse height discrimination, pulse shaping, coincidence measurements, and square wave generation are discussed. The specific application of these circuits to problems in nuclear instrumentation is also considered. (auth)

26251 SIMPLE SCHEME FOR USING THE SELECTIVE STORAGE OF A MULTICHANNEL PULSE HEIGHT ANALYSER IN COINCIDENCE COUNTING. Rolf Nordhagen (Universitetet i Oslo, Blindern, Norway). Nuclear Instr. & Methods, 12: 151-4(June 1961). (In English)

A description is given of a simple scheme for using one single channel analyzer in the simultaneous selective storing of two coincidence spectra in the memory of a R.C.L. 256 channel pulse height analyzer. An extension of this scheme to observing simultaneously four spectra coincident with four adjacent channels is mentioned. (auth)

26252 OPERATION OF MICROTRONS WITH SECTORED MAGNETS. A. Paulin (J. Stefan Institut, Ljubljana, Yugoslavia). Nuclear Instr. & Methods, 12: 155-68(June 1961). (In German)

The possibility of building a racetrack microtron for electrons is discussed. With proper adjustment of distances, voltages and phases between various elements, the electrons can be obtained by field emission in the accelerating gap. Strong focusing magnetic fields are not necessary for currents smaller than 1 μA. For currents above 1 μA it would be convenient to use quadrupole lenses for the focusing of the accelerated beam. There is a possibility of building a high energy electron accelerator with extremely low energy spread using the microtron in combination with a linear accelerator. (auth)

26253 HODOSCOPE SYSTEM FOR EXPERIMENTS ON THE SCATTERING OF COSMIC RAY MU-MESONS. PART III. THEORY OF THE HODOSCOPE. M. A. Meyer, J. A. M. de Villiers, and J. A. J. Van Der Walt (Potchefstroom Univ. for C. H. E., South Africa). Nuclear Instr. & Methods, 12: 180-6(June 1961). (In English)

The hodoscope which was designed for experiments on the scattering of cosmic ray mu-mesons has proved to be a very effective and fast method for determining the scattering function of mu-mesons. The theory of the instrument is discussed. In its present form the useful energy region of this hodoscope is below about 600 Mev but this can easily be increased to energies below a few Bev's. (auth)

26254 ADAPTATION OF A $\pi\sqrt{2}$ BETA-RAY SPECTROMETER FOR COINCIDENCE EXPERIMENTS. Ziemowid Sujkowski (Nobel Inst. of Physics, Stockholm). Nuclear Instr. & Methods, 12: 187-91(June 1961). (In English)

A large iron-core double-focusing β-ray spectrometer with a mean radius of 50 cm is adapted for coincidence experiments involving electrons. It is shown that satisfactory protection of the photomultipliers from the magnetic field can be obtained by means of a local field compensation with suitable Helmholtz coils. Some examples of applications are given. The doppler shift of the Th (B + C + C") A-line due to the α-decay of Bi^{212} is demonstrated. Some $\alpha - e^-$ and $\gamma - e^-$ directional correlations are measured. (auth)

26255 A STABLE 0.1% BEAM CURRENT INTEGRATOR FOR THE RANGE 0.1 TO 20 μA. G. J. F. Legge (Univ. of Melbourne). Nuclear Instr. & Methods, 12: 195-7 (June 1961). (In English)

A beam current integrator is described which is stable against short term calibration drifts. It has an accuracy of 0.1% and is linear to the same degree from 0.1 to 20 μA, above which the calibration changes by 0.1% per 20 μA. (auth)

26256 FURTHER COMMENTS ON ACCIDENTAL COINCIDENCES IN FAST-SLOW COINCIDENCE SYSTEMS. E. Brooks Shera (Western Reserve Univ., Cleveland). Nuclear Instr. & Methods, 12: 198(June 1961). (In English)

In the determination of the accidental coincidence rate in two-fold fast-slow coincidence systems by Mayer-Kuckuk and Nierhaus, a correction must be made in using their method for calculating the chance rate of a two-fold fast-slow circuit since their calculations apply to a three-fold circuit. In a two-fold system a term is needed for the finite resolving time of the fast coincidence circuit. This term is $N^{12} = 2t_f N_1 N_2$, where $2t_f$ is the resolving time of the fast

coincidence circuit and N_1N_2 are the counting rates from the amplitude selectors. This term can be determined by inserting an appropriate delay in either input to the fast coincidence circuit. When estimating the magnitudes of the remaining accidental terms, those derived by Mayer-Kuckuk and Nierhaus, the effect of dead times in the detectors and electronic circuitry before the slow coincidence circuit should not be neglected just in case the detector or circuitry is inoperative for an interval following an event. (N.W.R.)

26257 HIGHER ORDER EVENTS IN COINCIDENCE COUNTING. R. E. Bell (McGill Univ., Montreal). Nuclear Instr. & Methods, 12: 199-200(June 1961). (In English)

Arguments of high order chance events in fast-slow coincidence arrangements are presented. It is argued that the higher order events, discussed by Paul, are not necessarily chance coincidences, that they are not a special property of fast-slow circuits, and that they can be largely eliminated in a simple way. (N.W.R.)

26258 MAXIMUM LIKELIHOOD DETERMINATION OF THE SCATTERING CONSTANT OF AN EMULSION TRACK IN THE PRESENCE OF NOISE. L. Jánossy (Central Research Inst. of Physics, Hungarian Academy of Sciences, [Budapest]) and P. Rőzsa. Nuovo cimento (10), 20: 817-35 (June 1, 1961). (In English)

Formulas are deduced for the determination of two parameters of an emulsion track by the maximum likelihood method. The parameters are the constant of the Coulomb scattering and the amplitude of background noise. Numerical expressions are obtained for the scatter of the measured values of these constants and it is shown, e.g., that in case of very fine subdivision of a track the statistical error of the constants thus obtained decreases proportionally to $N^{-1/2}$, where N is the number of sections. Formulas are obtained which are useful for the practical determination of the parameters and which give accuracies only slightly smaller than that obtained by the optimal maximum likelihood method. Graphs are provided to facilitate numerical computations. (auth)

26259 REMARKS UPON THE DENSITOMETRY OF THE TRACKS OF HEAVY NUCLEI IN NUCLEAR EMULSION. D. Evans and R. R. Hillier (Univ. of Bristol, Eng.). Nuovo cimento (10), 20: 936-48(June 1, 1961). (In English)

An analysis of the structure of tracks of heavy nuclei in nuclear emulsion leads to a method whereby charge scales appropriate to any given parameter which has arisen through measurement upon a track by means of a densitometer may be calculated. As an example, the mean widths of tapers at a residual range of 100 μm are calculated for various values of the charge and good agreement with experimental results is obtained. (auth)

26260 THEORY OF AN ELECTROSTATIC PROBE IN A STRONG MAGNETIC FIELD. Bruno Bertotti (Princeton Univ., N. J.). Phys. Fluids, 4: 1047-52(Aug. 1961). (MATT-56)

If the magnetic field is so strong as to impair collective transverse drifts, all the charges supplied to the probe come mainly from a long tube of force, whose section is about one Larmor radius larger than the probe; while a diffusion process, more efficient than ordinary drifts, continuously exchanges particles between the inside and the rest of the plasma. A one-dimensional model of this process is proposed, leading to an integro-differential Poisson's equation, which has been studied for the case in which the collected particles are very fast. The solution consists of a chargeless, slowly decaying potential which describes the geometrical screening effect of the probe; while in the sheath an approximate boundary-layer solution matches with the probe's potential. (auth)

26261 EXPLOITATION OF THE p-n JUNCTION OF SEMICONDUCTORS FOR DETECTION OF IONIZING RADIATION. Karel Huml (Charles Univ., Prague). Pokroky mat. fys. a astron., No. 4, 424-31(1960).

The general properties of n and p type semiconductors and of n-p junctions are described, and it is shown that these properties may be exploited in radiation detection and measurement. The interaction of radiation with the junction, types of circuitry that may be used with junctions, and junction materials are discussed. (D.E.B.)

26262 RADIATION INSTRUMENTATION ELECTRONICS FOR THE PIONEERS III AND IV SPACE PROBES. Conrad S. Josias (California Inst. of Tech., Pasadena). Proc. I.R.E. (Inst. Radio Engrs.), 48: 735-43(Apr. 1960).

One of the devices carried aboard lunar payloads, Pioneer III and Pioneer IV, was a radiation measurement instrument. Its purpose was to detect and process information on particle flux rates encountered along the nominal cis-lunar trajectory to be followed by those payloads. Radiation data were collected by two different Geiger-Mueller tubes. One tube registered particle counts and the resultant accumulation was stored in a 17-stage scaler. The other tube provided average pulse current that was a compressed function of the counting rate. This current was fed to a resistor and the voltage thus formed was transferred to a telemetering subcarrier oscillator by way of a stable d-c amplifier. The electronics discussed fall into three groups: d-c amplifier for the analog experiment, high-voltage circuitry for the detectors, digital circuitry for the counting experiment. Details of the encoding system, which permits a large dynamic range of counting rates to be clearly presented on a single subcarrier, are also discussed. (auth)

26263 MICROWAVE MEASUREMENT OF MOBILITY: ANALYSIS OF APPARATUS. S. H. Liu, Y. Nishina, and R. H. Good, Jr. (Ames Lab., Ames, Iowa). Rev. Sci. Instr., 32: 784-9(July 1961).

The microwave mobility in a semiconductor can be obtained by mounting a sample in a bimodal cavity with an applied static magnetic field and then measuring the power transfer produced by the Faraday rotation in the sample. An analysis of the effect, based on the field distributions in the cavity and the wave propagation in the sample, is given. The dependence of the power transfer on the static applied magnetic field, on the mobility and conductivity of the sample, and on an effective sample size is obtained. (auth)

26264 MICROWAVE MEASUREMENT OF HALL MOBILITY: EXPERIMENTAL METHOD. Y. Nishina and G. C. Danielson (Ames Lab., Ames, Iowa). Rev. Sci. Instr., 32: 790-3(July 1961).

Hall mobilities of germanium single crystals were measured at a frequency of 9000 Mc over the temperature range 30–300°K. A rectangular sample occupied the central part of a wall of a rectangular cavity, which was doubly degenerate in the TE_{101} mode and in the TE_{011} mode at a single resonance microwave frequency. The external magnetic field and the microwave field associated with one of the two modes gave rise to the other mode of oscillation. The theoretical analysis of Liu, Nishina, and Good was verified by measurements on an n-type sample having a room temperature resistivity of 0.40 ohm cm. The measured Hall mobility at microwave frequencies (with a size correction) was compared with the dc Hall mobility between 30 and 300°K. The agreement was excellent. (auth)

26265 FUSED SALT SPECTROPHOTOMETRY. I. FURNACES FOR A CARY MODEL 14 SPECTROPHOTOMETER. John R. Morrey and Anthon W. Madsen (General Electric Co., Richland, Wash.). Rev. Sci. Instr., 32: 799-801(July 1961). (HW-SA-2090)

Furnaces which can be readily installed or removed from the sample and reference compartments of an unmodified Cary model 14 spectrophotometer are described. Heat requirements to 800°C are given for these units. (auth)

26266 IMPROVED ELECTRON FILTER LENS. J. Arol Simpson and L. Marton (National Bureau of Standards, Washington, D. C.). Rev. Sci. Instr., 32: 802-3(July 1961).

A filter lens of improved characteristics obtained by use of an intermediate image is described. The design has the advantage of longer focus and increased aperture while maintaining an energy resolution, at 5-kev primary energy, of less than thermal spread of the initial beam. (auth)

26267 ALL-METAL VALVE FOR ULTRA-HIGH VACUUM USE. R. B. Thorness and Alfred O. Nier (Univ. of Minnesota, Minneapolis). Rev. Sci. Instr., 32: 807-10(July 1961).

A demountable solderless all-metal valve suitable for ultra-high vacuum applications is described. A gasketed stainless steel diaphragm transmits the motion. Valves of several sizes were constructed. One modification is useful for providing a straight path for passage of a beam of particles or light between chambers which it may be necessary to evacuate separately. A pair of valves in a common block may be used to provide a convenient, accurate metering volume. A group of valves machined from a single block may form a complete manifold. The basic mechanism was also employed for transmitting motion in a high vacuum system as for adjusting a slit. (auth)

26268 AUTOMATIC DEVELOPMENT OF NUCLEAR EMULSIONS. C. A. Bovet and E. Jeannet (Université, Neuchâtel, Switzerland). Rev. Sci. Instr., 32: 819-21 (July 1961).

An automatic device to develop nuclear plates was built. The replacement or the dilution of the liquids and the changes and stabilization of the temperatures are controlled by an electronic program device using a transparent tape and a connection matrix. Use is made of temperature development in wet conditions. Tests showed homogeneity and reproducibility within 1%. (auth)

26269 LOW IMPEDANCE BRIDGE FOR THE MEASUREMENT OF LEVEL OF LIQUID METALS. Julius Hyman, Jr. (Rocketdyne, Canoga Park, Calif.). Rev. Sci. Instr., 32: 833-7(July 1961).

A means is described whereby the liquid level of sodium or other conducting liquids may be determined within a sealed metal system. The measurement obtained is that of electrical resistance in an attached drain tube used as a metal "sight tube." A large alternating current is induced for the measurement by using the sealed metal system itself in conjunction with the "sight tube" as a one turn secondary of a transformer. Techniques necessary for application and temperature compensation are discussed. (auth)

26270 RESISTANCE STRIP MAGNETIC ELECTRON MULTIPLIER. G. W. Goodrich and W. C. Wiley (Bendix Corp., Detroit). Rev. Sci. Instr., 32: 846-9(July 1961).

A magnetic electron multiplier which utilizes a strip of semiconductor material rather than conventional multielement dynode structure is described. Especially suitable for use in demountable vacuum systems, it amplifies and detects the electrons which result from bombardment of the cathode with ions, neutral molecules, photons, etc. Gains over 10^7, and dark currents lower than 0.1 electron per second referred to the cathode have been obtained. The addition of crossed field gates to rapidly direct the output beam to any one of several output anodes is discussed. Theory of operation and results of experimental measurements are reported. (auth)

26271 EPOXY RESIN AS A MATERIAL FOR CONSTRUCTING CRYOGENIC APPARATUS. R. G. Netzel and J. R. Dillinger (Univ. of Wisconsin, Madison). Rev. Sci. Instr., 32: 855(July 1961).

An epoxy resin was used successfully as a cement and as a construction material in experimental investigations at temperatures below 1°K. The cured resin capsules were nonmagnetic, electrically insulated, and could be machined to specific dimensions. Heating was unnecessary in constructing the capsules and many electrical leads could be brought out. Seals formed by the resin to join two pieces of cast resin, or cast resin to metal, or two pieces of glass were all vacuum tight, even in the presence of liquid helium below 2.18°K. (L.N.N.)

26272 ELECTRODIALYSIS UNIT FOR FISSION PRODUCT SEPARATION. G. J. Bub and W. H. Webb (Univ. of Missouri, Rolla). Rev. Sci. Instr., 32: 857(July 1961).

Fission products from the solvent extraction treatment of dissolved fuel elements were separated into three fractions by a 3-cell electrodialysis unit consisting of an anode cell, an anion exchange membrane, a cathode cell, a cation exchange membrane, and a feed cell. Representing the three fractions were zirconium-95, cesium-137, and cerium-144. The cesium-137 migrated to the cathode as a positive ion, the zirconium-95 to the anode as a negative ion, and cerium-144 remained as a radiocolloid in the feed cell. Fractional separation is thus possible on a laboratory scale. These principles may also be used for pilot plant operations. (L.N.N.)

26273 ELECTROSTATIC FIELD CORRECTION USING TAPERED ROSE SHIMS. Leonard A. Dietz (Knolls Atomic Power Lab., Schenectady, N. Y.). Rev. Sci. Instr., 32: 859-60(July 1961).

Rectangular Rose shims may be used to improve field uniformity in an electrostatic analyzer used in a mass spectrometer (NSA 15: 6171). Depending on how a field boundary is terminated beyond a Rose shim, the required thickness for a rectangular shim can be considerably greater than that predicted by Rose's theory. Field uniformity and dimensions of a tapered shim in an electrostatic field were determined by using a field plotting technique (NSA 13: 12621). It was shown necessary to double the rectangular shim thickness predicted by Rose's theory, or to use a tapered shim as was done. (L.N.N.)

26274 REDUCTION OF POTASSIUM ION BACKGROUND IN TUNGSTEN SURFACE IONIZATION DETECTORS FOR MOLECULAR BEAMS. E. F. Greene (Brown Univ., Providence). Rev. Sci. Instr., 32: 860-1(July 1961).

A technique is described for producing surface ionization detectors which solve the problem of potassium atoms in tungsten (NSA 15: 14494) and which are produced in a manner similar to that of Frazer, Burns, and Barton (NSA 13: 14491). The detector proper was a tungsten ribbon supported at each end by hairpin bends of tungsten wire. After an outgassing, the detector was exposed to the vapor in equilibrium with solid $W(CO)_6$ at about 35°C. The CO was pumped off a few times and a coat of tungsten was deposited on the ribbon and the wire. (L.N.N.)

26275 PRACTICAL DIFFERENTIAL FILTER FOR OPTICAL PUMPING WITH SODIUM LIGHT. Thomas R. Carver, Frank R. Lewis, Jr., Robert E. Pollock, and Glen Schrank (Princeton Univ., N. J.). Rev. Sci. Instr., 32: 861-2(July 1961). (PUC-1961-33)

Opitcal orientation of alkali metal vapors by polarized resonance radiation may be enhanced by reducing the intensity of the D_2 component relative to the D_1 intensity (NSA 11: 603; 12: 5456). A simple method to filter out the sodium D_2 light by more than a magnitude, without reducing the D_1 intensity much more than the usual amount necessary to form circularly polarized light, uses the different Zeeman splittings of the two D lines in a sodium vapor absorption cell placed in a magnetic field to open a transmission window in the center of the D_1 line, while still absorbing strongly in the center of the D_2. (L.N.N.)

26276 CAPABILITIES OF LITHIUM DRIFTED p-i-n JUNCTION DETECTORS WHEN USED FOR GAMMA-RAY SPECTROSCOPY. Norman A. Baily, Robert J. Grainger, and James W. Mayer (Hughes Aircraft Co., Culver City, Calif.). Rev. Sci. Instr., 32: 865-6(July 1961).

Lithium drifted p-i-n silicon junction detectors were used in gamma spectrometry. The data, recorded under "poor geometry," are presented graphically. (L.N.N.)

26277 THE RESPONSIVITY PROFILE OF PHOTOMULTIPLIERS. Hector C. Ingaro and Jay M. Pasachoff (Harvard Coll. Observatory, Cambridge, Mass.). Rev. Sci. Instr., 32: 866-7(July 1961).

Photomultiplier responsivities were observed as photocathode profiles. Profile shapes depended on manufacture processes, photosurface types, electron optics designs, voltages applied to the electrodes and their effects on collection efficiencies, "shadows" of focusing grills, and shapes of the photocathodes. General differences between phototubes with semitransparent and opaque photocathodes and between tubes with focused and unfocused electron optics were found. (L.N.N.)

26278 EFFECT OF REFLECTION ON THE PERFORMANCE OF MECHANICAL NEUTRON MONOCHROMATORS. Laurence Passell, William C. Dickinson, and William Bartolini (Univ. of California, Livermore). Rev. Sci. Instr., 32: 870-1(July 1961).

The effect of total reflection on the calculated transmission function of mechanical monochromators is discussed. The critical angle for total reflection of neutrons with wavelength λ from a smooth surface is given by $\Theta_c = \lambda(N_a/\pi)^{1/2}$, where N is the density of the nuclei and a is the coherent scattering amplitude averaged over the nuclei forming the surface. The monochromator should be made of a material with a small coherent and large incoherent and/or absorption cross section. (L.N.N.)

26279 SELECTED TOPICS IN RADIATION DOSIMETRY. Proceedings of the Symposium on Selected Topics in Radiation Dosimetry, Held in Vienna, 7-11 June 1960. (International Atomic Energy Agency, Vienna). 1961. 694p. (STI/PUB/25). $9.50(domestic), Sch 199.50(DM 30.40) (foreign) (57s. Od. stg; NF 38).

Seventy papers are included; separate abstracts have been prepared for 67. Three papers were previously abstracted in NSA. Eleven of the papers are in French, six in Russian, and one in Spanish. Presented in this meeting were the problems encountered in measuring radiation and the techniques used. (N.W.H.)

26280 THE ACCURATE COMPARISON OF EXPOSURE DOSE-RATE (OUTPUT) FROM GAMMA-EMITTING RADIOISOTOPES USING CAPACITOR IONIZATION CHAMBERS. R. L. Otlet and J. D. George (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.53-66 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The exposure dose-rate at fixed distances from similar cobalt-60 sources is accurately compared by a technique employing commercially available capacitor ionization chambers and an electrometer. The readings obtained by repeated exposure of a group of chambers positioned around the sources are analysed to determine the weighted mean ratio of two dose rates and the standard error of the weighted mean taken as a measure of the precision of the measurement. Particular attention is given to sources of systematic error, pressure, temperature, charging potential, and exposure time. The application of the technique to calibrate the effective activity of a wide range of cobalt-60 dosimetry standards, extrapolating from low activities, is described. The development of the technique to calibrate standards of other radioisotopes and the measurement of absolute dose-rate output are also considered. (auth)

26281 SMALL INSTRUMENTS FOR THE AUTOMATIC REGISTRATION OF DOSE-RATES TO BE WORN BY PERSONS EXPOSED TO X-RAYS AND γ-RAYS. R. M. Sievert (Inst. of Radiophysics, Stockholm). p.105-15 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Some very small instruments which indicate how the dose-rates vary are developed. The records are made on a registration disc 24 mm in diameter. The resolving power is of the order of $\frac{1}{10}$ to $\frac{1}{2}$ of a minute in time and the sensitivity can be changed within the range of some ten μrad to several hundreds of rad. The registrations are evaluated with a microscope or by means of magnification on photostatic paper, but even a glance at the registration disc through a magnifying glass will show whether a substantial change in the dose-rate has taken place. The last type of instrument developed has a weight of about 200 g. Various types of ion chambers can be attached to it. (auth)

26282 INSTALLATION FOR CALIBRATION IN ROENTGENS IN THE RANGE OF ENERGIES BETWEEN 250 AND 3,000 kev. K. K. Aglintsev. p.117-21 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In Russian)

A calibrating apparatus for measuring gamma-rays in roentgens is described. The apparatus consists of a flat ionization chamber located in a compressed-air tank, electrical measuring and diaphragming instruments, and a bench for calibrating dosimeters. The necessary corrections to the readings obtained are discussed. The optimum calibration conditions are established. By making parallel measurements of the gamma radiation emitted by preparations with the calibrating apparatus and with gamma calorimeters, it is possible to determine experimentally the absorption coefficient of the preparation, the gamma-constant value of the isotope and the degree of ionization in air. (auth)

26283 AN ELECTROMETER WITH LOGARITHMIC RESPONSE. R. Boulenger, E. Gourski, and C. Jonckheere (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). p.123-30 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

A simple electrometer circuit with logarithmic response is built for the measurement of currents in the range 10^{-13} to 10^{-7} A. The input valve used is an electrometer triode, ME 1401 (Mullard) or 4065 (Philips). The measuring error

of this circuit is less than 3% over the entire range of input currents. The same accuracy is obtained in a circuit using a pentode E80F in triode connection as input tube, enabling the measurement of currents in the range 3×10^{-11} to 3×10^{-5} A. The use of the electrometer triode ET3 (GEC) enables a logarithmic response over nine decades of currents: 10^{-14} to 10^{-5} A. In the range 10^{-14} to 10^{-6} A the error will be less than 3%. Toward the higher end of the range (10^{-5} A) the error gradually increases to 10%. The operation of the circuit is based on the logarithmic relationship existing between grid current and grid voltage, and thus anode voltage, of the input tube, the anode current being kept constant. The circuit layout is completely symmetrical, thus greatly minimizing the effect of variations of heater voltage, supply voltage and to a certain extent tube characteristics. The output current proportional to the logarithm of the input current is actually determined by the difference between the grid voltages of the input tube and a reference tube of the same type. Apart from the VR-tube stabilized power supply, this electrometer circuit consists only of the two electrometer triodes and one double triode, type 5692. (auth)

26284 AN ION CHAMBER WITH A WALL OF AIR. F. Tranter (Christie Hospital and Holt Radium Inst., Manchester, Eng.). p.131-4 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Two designs of ion chambers are constructed and used. One is calibrated against a standard free air chamber using low-voltage x-rays (Grenz rays) between about 10 and 50 kv, and it has a very good flat characteristic. The second chamber is designed for measuring on the surface of a scattering medium. Both chambers work with a collecting volume of about 0.5 ml of air; both chambers have a guard ring construction and are designed to feed a standard valve amplifier. It is anticipated that these chambers, although designed for work with low-voltage x-rays, will serve a much wider purpose. (auth)

26285 A SIMPLE POCKET DOSIMETER WITH EXTENSIVE MEASURING RANGE. R. Walstam (Inst. of Radiophysics, Stockholm). p.135-40 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The radiation detector described consists of two thin-walled concentric ionization chambers having different sensitivities. The measuring range of these two ionization chambers together covers two powers of 10. Each pocket dosimeter used for radiation protection measurement consists of two sets of such double chambers in a plastic container. The physical properties of the instrument are carefully studied. The double-chambers are used in extensive protection measurements of Radiumhemmet (about 5,000 readings annually). The personnel exposure in different departments is followed by continuously running measurements using measuring periods from two days to one week. From dose distribution studies on personnel in different types of work, the dose distributed to different organs is known. The results of the measurements are analyzed and compared with the dose limits recommended by the ICRP. (auth)

26286 IONIZATION CHAMBER DETECTORS MORE PARTICULARLY ADAPTED FOR INDUSTRIAL MONITORING. M. Ganouna and H. Rigaut (Centre d'Etudes Nucléaires, Saclay, France). p.141-3 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In French)

Some suggestions are made for improving the ionizing radiation detection equipment used in connection with health protection. The described simple and reliable system offers an immediate solution to the problem of dosimetry using a summation device; this system is very irksome with D.C. amplifiers and recorders. The system has the following characteristics: response of the order of 10^{-3}; calibration accuracy of the order of 3×10^{-3}; sensitivity dependent only on the insulators; 10^{-14} A being normal; and useful life of the contacts: 6×10^{7} operations without any sign of deterioration being observed. (auth)

26287 SATURATION OF AN IONIZATION CHAMBER USED FOR THE DOSIMETRY OF PULSED RADIATION. J. Allewaert (Université, Gand, Belg.). p.145-9 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In French)

Boag's calculations show that the fraction f of the ions collected when an ionization chamber is subjected to pulsed radiation is given by the formula: $f = (1/u)\ln(1 + u)$. For a parallel electrodes chamber there is the formula $u = \mu(r\,d^2/V)$. Boag verified the relationship experimentally by irradiating chambers with x-rays emitted by a 4 Mev linear accelerator. When measurements were made for $r = 1.2$ and $r = 0.52$, the distances d were between 0.48 mm and 1.98 mm. The experimental points closely encircle the theoretical curve. The experiments are extended to lower r figures obtained with a betatron. A spacing of $d = 10.0$ mm and $d = 2.0$ mm was chosen for the ion chamber. Exposing the chamber to a 15 Mev electron beam, values for r between 0.2 and 0.006 were obtained. By varying V the useful part of the saturation curve was explored. (auth)

26288 IONIZATION CHAMBERS FOR MEASURING LARGE RADIATION DOSES. L. Bozóky (Central Inst. for Oncology, Budapest). p.151-5 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The condenser-chamber r-measuring technique seemed the most suitable for measuring large radiation doses. Wide range and reduced measuring volume are obtained by an airtight condenser chamber, filled before sealing with low-pressure dry air. Vacuum treatment and low-pressure air filling have resulted in the excellent preservation of the charge of the chamber, the airtight sealing has secured its absolute insensitivity to vapor, dust, water, atmospheric pressure, and temperature. The inner electrode has no permanent outlet through the sealed airtight envelope; it is connected to the outlet auxiliary electrode only for the duration of measurement and charging, when subjected to the action of a magnet. Experiments have proved that the linear relationship existing between dose and charge loss may be influenced significantly by the special design of the air space. Thus small doses at the first part of the scale may be read off with the same accuracy as large doses near full scale. Test results obtained with such chambers, their energy dependence, preservation of charge, accuracy, and practical experience concerning their use are treated; and a special charging and measuring device necessary for their operation is described. (auth)

26289 EXPERIENCES WITH A SPECIFIC RADIATION EFFECT ON THE CONDENSER IN CONDENSER-IONIZATION CHAMBERS. K. Gussgard (State Inst. of Radiation Hygiene, Oslo). p.157-60 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Dose measurements with condenser chambers may in certain cases show an unsatisfactory reproducibility. Investigations have shown that discontinuities in the conducting layers of the condenser may cause a systematic

radiation effect. Irradiation of an uncharged condenser of this nature introduces an electric charge to the system, with the result that subsequent irradiation of the fully charged chambers leads to an additional discharge through the condenser. This extra discharge can occasionally be of the same order of magnitude as the discharge through the ionization volume. The effect can be demonstrated for doses down to 0.1 r (x-rays). (auth)

26290 ERRORS INTRODUCED BY FINITE SIZE OF ION CHAMBERS IN DEPTH-DOSE MEASUREMENTS. K. V. H. Lidén (Univ. of Lund, Sweden). p.161-72 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The change in the relative sensitivity of different-sized ionization chambers when measuring in a water-equivalent medium instead of in air was studied. A careful experimental comparison was made between three different cylindrical chambers. The angular and energy dependence was first thoroughly studied. Dose measurements were then performed at four different depths in a phantom using four different radiation qualities. In order to secure the necessary accuracy of the measurements, several irradiations of each pair of chambers were performed in a carefully designed geometry; the small heterogeneity of the x-ray beam was smoothed out by cyclic permutations, etc. In the energy and depth ranges studied, the dose measured with the largest chamber was up to 7% larger than with the smallest one. A comparison of this result with data calculated from depth-dose tables shows that the decreased filtration of the primary beam in chambers with larger diameters will only account for part of the observed effect. The other part must be ascribed to the decreased filtration of the scattered radiation in the cavity by the chamber. (auth)

26291 IONIZATION CHAMBER RECOMBINATION LOSS IN HIGH-INTENSITY RADIATION FIELDS. R. Loevinger (Stanford Univ., Calif.). p.173-81 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Ionization measurements in high-intensity radiation fields are often limited by uncertainty as to the fraction of the ionization lost by recombination in the gas. Measurements of recombination loss are made and in some circumstances are not in agreement with presently available theoretical predictions. The recombination loss can be empirically determined, as follows. For a fixed radiation intensity the ion current (I_v) is observed as a function of collecting voltage (V). A linear relationship exists between I_v and a suitable inverse power of V: $I_v = I_\infty (1 - \alpha V^{-n})$ provided $I_v/I_\infty > 0.9$. The exponent n lies between 0.5 and 2.0 in measurements made so far, and has the value unity for pulsed beams. Both n and the recombination slope α may be functions of I_∞, chamber geometry, polarity of the collecting voltage, and the nature of the radiation field (i.e., pulsed or steady). The experimental results show agreement with the Boag theory of volume recombination at high radiation intensities, and indicate a transition to columnar recombination at lower intensities. (auth)

26292 EXPERIMENTAL STUDY OF ELECTRON EQUILIBRIUM IN GAMMA-RAY IONIZATION CHAMBERS. K. K. Aglintsev, V. V. Mitrofanov, and V. V. Smirnov. p.183-90 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In Russian)

Processes taking place in gamma-ray ionization chambers can be interpreted only if the energy spectra and spatial distribution of secondary electrons occurring in the chamber walls and penetrating the measuring volume are known. By using a special magnetic spectrometer, a systematic study was made of electrons knocked out by Cs^{137} and Co^{60} gamma-rays from substances of different atomic number and different thickness. The absolute yield of secondary electrons was determined. The equilibrium thickness values of different substances were obtained experimentally. The relationships to air of the stopping powers of different substances were obtained for the case of electronic equilibrium. The research carried out made it possible to draw a number of conclusions regarding the correct use and calibration of ionization chambers when measuring gamma-beta-radiation. (auth)

26293 IONIZATION CHAMBERS WITH LIQUID AND THEIR PRACTICAL APPLICATION. I. Adamczewski (Polytechnic High School, Academy of Medicine, Danzig). p.191-201 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Discussed is the practical possibility of applying ionization chambers filled with liquid dielectrics in research on different ionization effects, but especially in neutron and cosmic-ray dosimetry. The most simple application is the use of ionization chambers of this type as x-ray dosimeters. The ionizing influence of x-rays on the conductivity of liquid dielectrics is very apparent. For a dose-rate of the order of 1 r per min, their conductivity increases to more than 40,000 times the self-conductivity value. The obstacles to the use of such chambers lie in the difficulty of designing an easily portable model in which the liquid can not be contaminated by carrying and in the need to use the ionization chambers for investigations of low-intensity cosmic rays and ionization bursts caused by these rays in the chambers. These chambers can be used with the high-pressure gas chambers. The influence of neutron radiation on the hexane conductivity by proton-recoil is investigated. Research upon the possibility of the investigation of carbon under photodisintegration in hexane by the 17.6 Mev photons – from the reaction $C^{12}(\gamma,3\alpha)$ – is in the final stage of preparation. (auth)

26294 PORTABLE DOSIMETER WITH A SCINTILLATOR. R. Boulenger and E. Gourski (Centre d'Etudes de l'Energie Nucléaire, Mol. Belg.). p.219-25 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In French)

An extremely simple and sturdy small instrument is constructed by utilizing the law of quasi-logarithmic variation of the input of a photomultiplier according to the illumination (produced by a scintillator) if its anodic current is kept constant. The measuring circuit is reduced to a few transistors. The range covers four decades (0.3 mr/hr to 3 r/hr). The divergence in relation to a logarithmic law is less than 10%. The stability as regards time is excellent; the temperature has very little influence (0.3%/°C). In principle a simple organic scintillator gives the instrument a response independent of power of more than 100 kev. The use of mixed scintillators to improve the low power response is under consideration. Even with low irradiation intensity, the response of this type of detector is remarkably quick, which makes it suitable for use in industry. (auth)

26295 THE INTERPRETATION OF PULSE-HEIGHT DISTRIBUTIONS IN ORGANIC PHOSPHORS. J. G. Moore and K. F. Orton (English Electric Co., Ltd., Whetstone, Leics, Eng.). p.227-35 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The absence of a clearly defined total absorption peak in all but very large organic phosphors has led to the use of the peak near the Compton edge for energy measurements. The spectra for medium- and small-sized phosphors are deduced theoretically by assuming a single scattering event within the phosphor. The differential scattering cross-section is used to obtain an energy spectrum of recoil electrons and it is then assumed that an electron of energy E gives rise to a pulse of height proportional to E but distributed about the mean value in accordance with a normal distribution whose standard deviation is proportional to $E^{1/2}$. The theoretical curves are derived for a variety of different resolutions and these are compared with experimentally determined spectra from a range of organic phosphors. It is shown that the observed curves can be interpreted in this manner and a conventional energy calibration can be obtained. (auth)

26296 SCINTILLATION METHODS FOR DISCRIMINATION OF PARTICLES ACCORDING TO THEIR SPECIFIC IONIZATION. Mario Forte and Amalia Konsta (CSNI, Ispra, Italy). p.243-52 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The first method of selecting the different scintillation amplitudes, produced by light and heavy particles in suitable combinations of inert and scintillating materials, is considered for the case of fast-neutron detection. The behavior of various compositions under neutron and gamma irradiation is described. More recent methods of discrimination use the dependence of the scintillation decay times on the specific energy loss of the particle. In many organic scintillators slow components follow the fast decay and are enhanced in the case of heavily ionizing particles. The particle discrimination based on this effect is possible by means of very simple techniques. Results obtained in using various organic scintillators for discrimination of fast neutrons are exposed. The behavior of inorganic scintillators seems to be rather complex and does not afford a uniform criterion for discrimination. In order to display any variation of the emission law a method is developed that consists in measuring the position of the cross-over point of the pulse formed after double RC differentiation of the scintillation current. By this method the conversion of pulses produced by electrons, protons, and alphas of spread energies into separated peaks of particles was tried for various scintillators, with different results. For instance, the separation was complete with CsI(Tl), whereas NaI(Tl) did not discriminate between protons and alphas. The method is also applied to organic scintillators and some cases are found very efficient. (auth)

26297 TEST APPARATUS FOR GAS SCINTILLATION COUNTERS. S. A. Baldin and V. V. Matveev (Inst. of Atomic Energy, Moscow). p.252-8 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In Russian)

An installation is described for conducting the investigations required to develop various gas scintillation counters. It provides the studies of scintillations in gas mixtures and pure gases under pressures up to 100 atm. Description is given of the vacuum and gas purification, circulation, compression, and mixing systems and of the scintillation chamber design. The first experimental results obtained with the apparatus are discussed. Using xenon and type FEU-24 photomultiplier with a p-quateriphenyl light converter, the energy resolution for the Po^{210} alpha-line is about 5%. (auth)

26298 ON THE INVESTIGATION OF SOME MATERIALS USED IN SCINTILLATION COUNTERS. S. A. Baldin, V. V. Matveev, and A. D. Sokolov (Inst. of Atomic Energy, Moscow). p.259-64 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In Russian)

The technique and results are reported from investigations of some materials used in scintillation counters as light converters, reflectors, and optical cement. A special chamber for the type SF-4 spectrophotometer is described to conduct investigations in the wave-length region from 2,000 to 6,000 Å. It also compiles the results of optical density studies of some materials utilized in scintillation counters for designing light guides and providing optical coupling between the detector and photocathode of the multiplier, discusses the effect of the material choice and its surface conditions on the amount and angular distribution of reflected light, and compares the conversion powers of p-quateriphenyl and sodium salicylate and their variation with the layer thickness. (auth)

26299 IMPROVEMENT OF PHOTOPEAK RATIO OF SCINTILLATION SPECTROMETERS. R. V. Gasstrom (International Atomic Energy Agency, Vienna). p.265-70 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

A short review is given of the main factors influencing, and the means adopted to improve, the photopeak of gamma scintillation counters in relation to the continuous spectrum of partially absorbed gamma-rays. Among other means, the collimation of the gamma-beam on the central portion of a scintillation crystal reduces the escape probability and hence enhances the photopeak ratio. The construction of a collimator utilizing the above principle is described and results obtained discussed. (auth)

26300 USE OF PHOTOGRAPHIC EMULSIONS FOR MEASUREMENT OF STRONG DOSES. INFLUENCE OF THE OUTPUT OF THE RADIATION SOURCE. N. Chassende-Baroz (Centre d'Etudes Nucléaires, Saclay, France). p.285-8 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In French)

None of the scientific studies published so far on photographic emulsions had revealed a deviation from the reciprocity law for x or γ radiation, except in the solarization region. Recent experiments carried out in collaboration with laboratories have shown that, for certain emulsions, a deviation of this type can exist, in either one direction or the other. This latter observation shows that it is possible to produce emulsions whose response is practically independent of the output of the source. Nondeviating emulsions for measuring doses of 0 to 800 r are produced; emulsions capable of recording up to 50,000 r are now being tested, and other emulsions for measuring doses of the order of 10^6 r are being prepared. (auth)

26301 FILTER COMBINATIONS FOR MIXED RADIATION FILM DOSIMETRY. G. Poretti (Reaktor A. G., Würenlingen, Switzerland). p.289-96 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

In film dosimeters for personal monitoring, different filters are used to evaluate the doses received from different types of radiation. Rhodium, tin, lead, and plastic are selected in such thicknesses and combinations as to meet the following two requirements. The blackening of the photographic emulsion should be approximately the

same for equal RBE-doses of thermal neutrons, γ-rays, and β-particles. The blackening of the emulsion by γ-rays should be independent of the γ-ray energy from 100 kev to a few Mev. Filters of rhodium + lead, tin + lead, plastic, and an open window meet these requirements rather well. The γ-dose is given by the blackening through a tin + lead filter; the γ-dose plus the RBE-dose of thermal neutrons through a rhodium + lead filter; and half the β-dose is given by the difference in blackening through an open window and a plastic filter. (auth)

26302 PHOTOGRAPHIC METHOD OF DOSE MEASUREMENTS OF X- AND GAMMA-RAYS EMITTED BY SEALED SOURCES USED FOR INDUSTRIAL APPLICATIONS. Józef Domanus and Leszek Halski (Electrotechnical Inst., Warsaw). p.297-308 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The test-film method determines in a simple way the dose distribution around radiation sources and radiation leaks. Persons using radioisotopic sources are exposed to gamma radiation of different energies lying within much broader limits than is the case with x-rays. Therefore it is necessary to prove that the film method is suitable for dose measurements of gamma-rays of such different energies and to choose a proper combination of film and intensifying screen to reach the desired measuring range. X-rays are also included in these investigations. As gamma-ray sources the radioisotopes Tm^{170}, Ir^{192}, Cs^{137}, $Eu^{152+154}$, Co^{60}, and Ra^{226} are used. Measurements of x-rays are made with energies ranging from 50 to 400 kvp. The investigations have shown that for dosimetric purposes the "Foton Rentgen Super" films are most suitable. Best results can be obtained with lead intensifying screens. (auth)

26303 CHEMICAL DOSE MEASUREMENTS OF HIGH-ENERGY PHOTONS AND ELECTRONS. W. Minder (Universität, Bern). p.315-23 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

As the yields of the Fricke dosimeter are now known with sufficient accuracy over a wide range of radiation qualities and energies, questions of general interest concerning energy dissipation, scattering problems, LET, polarization, and RBE may be resolved by this measuring system. A first group of our experiments deals with dose measurements of photons. X-rays between 14 kv and 31 Mv (BBC-betatron) are investigated as well as gamma-rays from radium, Co^{60} and Ir^{192}. It could clearly be demonstrated that conventional dose-measuring methods may be used for practical purposes without energy corrections over a wide range of energies, if not very high accuracies are needed. It was possible to establish the yields of the Fricke dosimeter for different energies and to compare some of them with calculated doses (sphere dosimeter principle). In a second group of experiments electrons of 10 and 30 Mev (BBC-betatron) and mixed beta-gamma radiation from Rb^{86} are investigated. The results again show the usefulness of chemical dose-measuring principles for these more difficult dosimetrical problems. They give additional information on the influences of electron scattering and polarization, which cannot be detected by conventional dose-measuring methods. (auth)

26304 LIMITATIONS ON THE USE OF FERROUS SULPHATE DOSIMETRY FOR MEASURING SMALL γ-RADIATION DOSES. G. Thielens (Université, Gand, Belg.). p.325-9 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In French)

Ferrous sulfate dosimetry has proved extremely useful for measuring doses from 4 to 40 kr. The ease of preparation and stability of the solution together with the simplicity of the measurement technique have greatly promoted its use. In conjunction with suitable techniques its use can be extended to small doses. Various methods of determining the Fe^{+++} ion were investigated. In addition, methods providing for the use of sensitizers to increase the G-value (F^{++} and Fe^{+++}) were investigated, and the lower limit of applicability was tested. The experiments on direct determination of Fe^{++} by absorption at 305 mμ in a non-sensitized dosimeter show that a dose of 300 r can be measured with sufficient accuracy. (auth)

26305 ENLARGED SENSIBILITY OF THE FRICKE DOSIMETER BY UTILIZATION OF THE ORTHOPHENANTHROLINE REAGENT. H. Bouzigues, J. Scheidhauer, R. Brian, and L. Messainguiral (Commissariat à l'Energie Atomique, Marcoule, France). p.331-5 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In French)

Determination of the dose, especially medium doses, of the residual ferrous iron, using the ferrous orthophenanthroline method is described. The formation of this colored complex is one of the reactions in most general use in the chemical analysis of iron traces. This method has the added advantage of taking the $Fe^{2+} \rightleftharpoons Fe^{3+}$ system in the state it is in at the end of irradiation, and of avoiding secondary effects of increasing in uncontrollable amounts the quantity of ferric ions formed (after-effect). Intense sources of radiocobalt and of PF are used, with very accurate results in a dose range from 1 to 30 kr. Studies are continuing with a view to increasing this utilization range in the very strong irradiation region. (auth)

26306 CHEMICAL AND COLORIMETRIC DOSIMETRY: THE TETRACHLOROETHYLENE CHEMICAL DOSIMETER SYSTEM. S. C. Sigoloff (Edgerton, Germeshausen and Grier, Inc., Goleta, Calif.). p.337-59 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

A chemical system that has many of the properties desirable in a gamma-ray dosimeter — namely, linearity, rate and temperature independence, and relatively fast neutron insensitivity — is available when the halogenated hydrocarbon tetrachloroethylene is prepared accordingly. Chemical dosimeters at the present state of development appear to offer a distinct potential for the measurement of gamma dose from a mixed radiation field. The tetrachloroethylene chemical dosimeter system is generally applicable for the dose range of approximately 5 to 5×10^6 rad. The chemical system as utilized for gamma dosimetry consists of tetrachloroethylene which contains a small amount of free radical chain reaction retarder overlayered with an aqueous phase containing a pH indicator. Chemical chain reactions induced by radiation liberate water soluble acids. The amount of radiation formed is directly proportional to dose within a given range. The response may be evaluated by titration of the acids produced, by change in conductivity of the solution, or by change in pH measured electrometrically or colorimetrically. Data on production, calibration and read-out techniques as well as radiation characteristics are discussed. (auth)

26307 THE USE OF POLYISOBUTYLENE SOLUTIONS FOR MEASURING DOSES FROM 10^3 RAD UP TO ABOUT 10^{10} RAD. L. Wiesner (Institut für Erdölforschung, Han-

over). p.361-70 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The depolymerization of polyisobutylene solutions in organic solvents under the action of γ-radiation is completely reproducible. The decrease of the viscosity of the above-mentioned solutions — measured by an Ubbelohde viscosimeter — is applied to determine absorbed γ-doses. Doses over a range of 10^3 can be measured by means of polyisobutylene solutions of about the same average molecular weight. The maximum error involved is about 3 to 4%. The relation of dose/viscosity is shown to be independent of temperature between 20 and 80°C. Concentrated solutions of low average molecular weight polyisobutylene are suitable for the measurement of higher doses, whereas conversely solutions of low concentration, high average molecular weight are more suitable to determine the lower doses. Measurements of doses within a range of 10^3 rad up to at least 10^{10} rad can be covered by this method. The nature of solvents and their influence in the measurements are discussed. (auth)

26308 ABSOLUTE MEASUREMENTS ON THE Co^{60} IRRADIATION FACILITY AT RISØ. N. W. Holm, A. Brynjolfsson, and J. E. Maul (Atomenergikommissionen, Risø, Denmark). p.371-6 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Described are some items in connection with the calibration of the Fricke dosimeter. A more reliable measurement is made of the molar extinction coefficient for the ferric ion: 2187 ± 5 at 25°C. The absolute dose measurement was carried out by means of an ice calorimeter and the G-value found was 15.68 ± 0.07. (auth)

26309 THE STATUS OF THRESHOLD AND RESONANCE NEUTRON DETECTORS. J. Moteff and E. R. Beever (General Electric Co., Cincinnati). p.383-98 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The status of threshold and resonance foil detectors for obtaining neutron spectrum information for in-pile and shielding experiments is presented. Various analytical and experimental methods including cross-section values are compared. Standardization requirements for dosimetry in support of radiation effects and shielding experiments are discussed. Some of the foils considered are Al, Cu, Fe, Mg, Ni, P, S, NaCl, Pu^{239}, Th^{232}, Np^{237}, U^{238}, and a Mn–Cu–Co Alloy. The processing of these foils in a large air-conditioned trailer, completely equipped as a portable counting laboratory, is discussed. A presentation is made of the results of specific experiments that are performed to investigate the fast neutron spectrum patterns throughout the reactor with a uniform withdrawal of control rods, the patterns in the reactor with a non-uniform withdrawal of control rods, the effect on the fast flux in an experimental hole that was heavily loaded with iron, and the fast neutron patterns as a function of thickness of shielding materials. Theoretical predictions of the fast-neutron spectrum in specified experiments are compared with the respective measurements. (auth)

26310 NEUTRON DOSE DETERMINATIONS WITH THRESHOLD DETECTORS. F. J. Davis (Oak Ridge National Lab., Tenn.). p.399-404 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Neutron dose measurements can be obtained by counting the gamma-ray activity induced in foils after irradiation in the neutron flux. The foils consist of Au and Au + Cd for determination of thermal flux, Pu^{239} shielded with B^{10} for determining total fast flux, Np^{237} for determining the flux above 0.75 Mev, U^{238} for determining the flux above 1.5 Mev, and S^{32} for determining the flux above 2.5 Mev. By appropriate weighting of the activities of these foils, the total neutron dose is obtained. Dose-rate measurements can be obtained by the use of these foils in conjunction with Au–Si surface barrier detectors which measure the fission fragments in fission foils or protons in the $S(n,p)P^{32}$ neutrons. (auth)

26311 SPECIAL COUNTING TECHNIQUES IN MIXED-RADIATION DOSIMETRY. G. S. Hurst and E. B. Wagner (Oak Ridge National Lab., Tenn.). p.409-17 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

With pulse-counting techniques one can measure the dose due to the two components of a mixture of neutrons and gamma-radiation even when the dose due to one of the components is more than 10^4 times the dose due to the other component. The fast-neutron measurements are carried out with proportional counters designed according to the Bragg-Gray principle. Gamma-radiation dose measurements may be carried out with a small, commercially available, halogen-type Geiger-Müller counter properly shielded to yield the correct energy-response curve. These examples serve to illustrate the flexibility of the counting methods as compared with the more conventional ionization methods. (auth)

26312 DETERMINATION OF GAMMA DOSES IN MIXED RADIATION FIELDS WITH A HURST-TYPE NEUTRON DOSIMETER. F. P. Pott and S. Wagner (Physikalisch-Technische Bundesanstalt, Brunswick). p.419-25 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The Hurst-type dosimeter, consisting of a proportional counter with polyethylene wall and ethylene gas, permits the determination of absolute neutron dose after energy calibration by an α-source. The main assumption for this procedure is the validity of the Bragg-Gray principle for fast neutrons in a homogeneous chamber. The Bragg-Gray principle holds also for γ-radiations up to 1 or 2 Mev in counters with 3 mm polyethylene wall. In mixed radiation fields the neutron dose is determined in a well-known way by summing up all pulse-heights due to recoil protons. The same counter operating as an ionization chamber with gas multiplication measures the total ionization produced by the mixed radiation field in ethylene. For the calculation of dose from ionization a knowledge of the gas multiplication factor is necessary. This may be obtained from the ratio of the chamber current under normal operation conditions to the chamber current for a gas multiplication factor equal to unity in the same γ-field, or from the ratio of the charges produced by a single α-particle under the aforesaid conditions. Moreover, an absolute measurement of the charge in a single α-pulse for a gas multiplication factor equal to unity permits the determination of the average energy spent in producing an ion pair in ethylene. This value may be used for computing the charge, corresponding to the neutron dose, which is to be subtracted from the total charge produced by the mixed radiation. From this difference, which is the charge produced by the γ-radiation only, the corresponding absorbed dose in ethylene may be obtained. (auth)

26313 FAST NEUTRON/GAMMA-RAY DISCRIMINATION IN ORGANIC SCINTILLATORS BY MODERATION OF THE FAST NEUTRONS. L. Tréguer (Centre d'Etudes Nucléaires, Saclay, France). p.427-33 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

In an organic scintillator, the fast neutrons are slowed down by successive collisions with hydrogen nuclei, the average time between two successive collisions being in the order of 4×10^{-9} sec. Moderation of a fast neutron after 3 or 4 collisions is associated with a luminous pulse, resulting from scintillations produced by the recoil protons. In a scintillator with a decay time of 4×10^{-9} sec, the neutron gives a pulse lasting over 6×10^{-9} sec, while γ-rays give pulses of 4×10^{-9} sec, the time interval between two Compton collisions being negligible. A discrimination on the basis of the difference in shape between the fast components of the pulses, enables one to count neutrons in the presence of gamma-rays. The resolution time is of the order of 10^{-7} sec. This method requires fast photomultipliers, 56 AVP or 58 AVP, and liquid scintillators over 2 liters in volume. With large-volume scintillators, direct spectrometry of fast neutrons becomes possible, with resolution in the order of 30%. (auth)

26314 IONIZATION TECHNIQUE FOR EVALUATION OF THE ABSORBED ENERGY IN THE MIXED FLUXES OF FAST NEUTRONS AND GAMMA-RAYS. Yu. Bregadze, B. Isaev, and V. Kvasov (Inst. of Biophysics, Academy of Sciences, Moscow). p.435-42 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In Russian)

The present investigation is devoted to a possibility of separate evaluation by means of thimble chambers of the absorbed energy from fast neutrons and gamma-rays in the mixed flux irradiated from a reactor. An assembly of three homogeneous ionization chambers containing different amounts of hydrogen is used and an analysis of the sensitivity of these chambers to neutrons of different energies in the range of 0.2 to 8 Mev is carried out. The change of neutron spectra within a wide range does not affect the accuracy of defining the absorbed dose in hydrogen containing substrates. The error in the evaluation of the absorbed energy from fast neutrons amounts to 15% and depends only slightly on the correlation between doses from neutrons and gamma-rays. (auth)

26315 A FAST-NEUTRON COUNTER FOR DOSIMETRY. J. Dennis and W. R. Loosemore (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.443-52 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (AERE-EL/R-2149). (In English)

A simply constructed counter is described for the measurement of fast-neutron flux. The counter takes the form of a series of polythene-lined cells with a common anode wire, and is filled with a mixture of methane and argon. The counting rate of a three-cell counter can be adjusted to within ± 20% of 0.9 cps per maximum permissible level (MPL) for fast neutron flux in the energy range 0.1 to 15 Mev. At this adjustment 219 MPL of radium gamma radiation or 99 MPL of thermal neutrons produce 0.9 cps. The counters are non-directional and are operated with an applied potential of 1400 v. (auth)

26316 A PROTON-RECOIL PROPORTIONAL COUNTER FOR FAST-NEUTRON DOSIMETRY. Ingvar Östen Andersson (Aktiebolaget Atomenergi, Stockholm). p.453-61 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The fast-neutron detector described has a sensitivity which varies with neutron energy in such a way as to keep proportionality between count-rate and dose-rate. It is considered to be of a simple and reliable construction. The sensitivity to neutron dose is 1.3 cps/0.1 rem/week. Gamma radiation of 1 r/hr from a radium source gives 2 cps. The calibration of the counter is performed with d-D and d-T neutrons from an 800-kev linear accelerator and p-T neutrons from a 3-Mev van de Graaff machine. The neutron flux measurements are carried out with an anthracene scintillation spectrometer with pulse decay discrimination, a LiI(Eu) scintillation spectrometer with a cooled crystal, and a methane recoil spectrometer. They are used as stationary monitors in reactor and accelerator halls and also in a portable instrument with transistorized electronics. (auth)

26317 A SIMPLE METHOD OF FAST-NEUTRON DOSIMETRY FOR USE IN RADIOBIOLOGY, AND AN INTERCOMPARISON WITH SOME METHODS USED IN THE UNITED STATES. G. J. Neary and F. S. Williamson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.463-71 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Fast-neutron dose in rad is calculated from measurements with a homogeneous ionization chamber of composition approximating to tissue; an exact knowledge of the neutron energy is not required. For a mixture of fast neutrons and gamma-rays, the dose-rates due to the two component radiations are evaluated separately by including a second chamber of low but known sensitivity to fast neutrons. Slow neutrons are allowed for by measurements with a boron trifluoride-filled chamber. Calibration is effected merely by exposing the chambers to a known dose-rate of gamma-rays from a standard source such as radium or cobalt-60. Intercomparisons were made recently in the United States between this measurement system and Rossi "Tissue-Equivalent" chambers at five monoenergetic neutron energies between 430 kev and 1.8 Mev. Agreement was within 13%. When exposed to known fast-neutron fluxes of 2, 3, and 5 Mev the measured dose compared to the calculated first collision dose was too high by 27%, 22%, and 19%, respectively. These discrepancies are being investigated and further intercomparisons are proceeding. (auth)

26318 SIMULTANEOUS MEASUREMENT OF THERMAL NEUTRON FLUXES AND GAMMA CONTAMINATION DOSE BY SILVER-ACTIVATED PHOSPHATE GLASS. S. Kondo (National Inst. of Genetics, Misima, Japan). p.491-6 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Taking wD_n as the energy imparted by thermal neutrons to a glass plate of weight w and wD_γ as the energy released to it by gamma contamination, one can assume the following for the fluorescent output: $I(x) = f(x)w(D_\gamma + D_n)$, where $f(x)$ is a proportionality constant which parametrically depends on x, the fraction by weight of $AgPO_3$ in the glass. Dividing the above equation by the fluorescent output $I_0(x)$ of the same kind of glass calibrated by gamma- or beta-rays of a known dose D_0, one has $I(x)/I_0(x) = D_\gamma/D_0 + D_n/D_0$. The D_n can be given by the first collision dose $D_n = \Phi \sum_{ji} n_i \sigma_{ij} E_{ij} = \Phi[A(1-x) + Bx]$, where Φ is the number of thermal neutrons per cm^2, n_i the number of i nuclei per gram; and $A(1-x)$ and Bx are the contributions from the base phosphate glass and $AgPO_3$, respectively. In this case, the dependence of $D\gamma$ on x is negligible. Thus, one obtains $I(x)/I_0(x) = ax + b$. Now, for the calibration exposure dose Γ_0 in r of Co^{60} gamma-rays, one has the following numerical equations: $\Phi = 2.41 \times 10^8\ \Gamma_0 a(n_{th}/cm^2)$ and $\Gamma = \Gamma_0(b - 6 \times 10^{-3}a)$, the gamma contamination dose in roentgen units. The glass plates ($10 \times 10 \times 3$ mm) of $AgPO_3$ added to the phosphate glass in ratios of 8:100, 10:100 and 12:100 by weight were exposed to mixed neutron-gamma radiation in the thermal column of JRR-1 in Japan. There was a good

linear relationship between $I(x)/I_0(x)$ and x. From the gradient a and the intercept b, Φ and Γ were calculated. The results are satisfactory. (auth)

26319 NEW HIGH-SENSITIVITY SILVER-ACTIVATED PHOSPHATE GLASS FOR THERMAL NEUTRONS. R. Yokota and E. Sakai (Tokyo-Sibaura Electric Co., Tokyo and Japan Atomic Energy Research Inst., Tokyo). p.497-501 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

A new silver-activated phosphate glass containing a large amount of Li and a small amount of B is described. This glass has a greater sensitivity to thermal neutrons than Schulman's glass. By exposing two pieces of glass covered one by a brass plate and the other by a cadmium plate, thermal neutrons and γ-rays can be measured separately. (auth)

26320 SILVER METAPHOSPHATE GLASS FOR GAMMA-RAY MEASUREMENTS IN CO-EXISTENT NEUTRON AND GAMMA-RADIATION FIELDS. J. A. Auxier, C. H. Bernard, and W. T. Thornton (Oak Ridge National Lab., Tenn.). p.503-10 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Small glass rods, composed of the metaphosphates of Al, Ba, K, and Ag, are exposed to both neutrons and gamma radiation to determine their suitability as gamma dosimeters in gamma radiation fields co-existent with neutrons. For energies less than 300 kev, the response per unit exposure dose is a function of photon energy with a peak at approximately 55 kev. Filters in the form of cylindrical capsules eliminate the major portion of this increased response per unit of exposure dose in the photoelectric region. The fast-neutron response was determined in the energy range of 0.5 to 1.5 Mev; the upper limit of response in this range of energies was 0.7% compared to Co^{60} gamma radiation in units of tissue rad. A thermal-neutron response equivalent to an exposure dose of 1 r of Co^{60} gamma-rays was induced by $(2.96 \pm 0.38) \times 10^9 n_t/cm^2$. Preliminary measurements with similar rods in which the elements Ba and K are replaced by Mg and Li, respectively, indicate a lower peak gamma-ray response per unit of exposure dose in the photoelectric region and an increased sensitivity to thermal neutrons; 1 r equivalent response was produced by $(3.7 \pm 0.4) \times 10^9 n_t/cm^2$. (auth)

26321 DOSIMETRY OF LARGE DOSES OF RADIATION BY COLORATION OR DECOLORATION OF GLASSES AND PLASTICS. A. Scharmann (Universität, Giessen, Ger.). p.511-19 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The radiation sensitivity of a great number of glasses, particularly lead glasses and phosphate glasses, and that of plastics were studied. Information is presented on spectral distribution of coloration and/or decoloration, dose sensitivity, bleaching-out, temperature sensitivity, and dependence on wave length. (auth)

26322 CERIUM-ACTIVATED SCINTILLATING GLASSES. R. Ginther (U. S. Naval Research Lab., Washington, D. C.). p.521-9 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Some cerium-activated glasses with promising scintillating properties are developed. A wide variety of glasses are synthesized employing nearly all of the activators known to produce luminescence in crystal phosphors, but scintillation pulses are obtained with only cerium-activated samples. The first group of scintillating glasses developed were borates, and the most efficient of these are a sodium-aluminum borate and a magnesium-aluminum borate. A somewhat more efficient glass is obtained by partial substitution of silica for boric oxide in the alkali-bearing glass to produce a sodium-aluminum borosilicate. The most efficient glass prepared is a lithium-magnesium-aluminum silicate having a pulse-height 14% of a NaI(Tl) crystal. The effect of compositional variation is studied extensively. The emission of all the above glasses lies in the near ultra-violet and blue region of the spectrum. Studies of the most efficient glass have revealed that some energy transfer from the base glass to the cerium activator takes place, and that the efficiency of glass scintillators is not limited by absence of energy transfer. The boron and lithium containing glasses of this investigation are found to detect thermal neutrons, and the sodium-aluminum borate glass appears to be a very promising detector for time-of-flight experiments. (auth)

26323 DOSIMETRY OF IONIZING RADIATION AND NEUTRONS WITH THE AID OF THERMOLUMINESCENCE. N. Häring and M. Schoen (Technische Hochschule, Munich). p.541-8 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The dose of ionizing radiation can be measured by thermoluminescence of powdered $CaF_2(Mn)$ crystals in the range 1 mr to 10^4 r. Energy (light sum) stored in irradiated samples (10 mg) is freed by heating and emitted as luminescent visible radiation. In the range mentioned the sum of the emitted light is proportional to the radiation dose. A dose exceeding 100 mr can be measured within 3%. The reproducibility of the crystals is very satisfactory (3%). There are some difficulties in measuring doses below 100 mr, connected with triboluminescence. These difficulties are considerably reduced by using conducting surface layers of SnO_2 on the $CaF_2(Mn)$ grains. With B^{10} or Li^6 layers it is also possible to measure slow or moderated neutrons. With Li^6F layers, the best results were obtained with a lower limit of 5×10^3 neutrons/cm^2. (auth)

26324 SOLID-STATE NEUTRON-GAMMA DOSIMETER. B. Gross and P. Murphy (Instituto Nacional de Tecnologia, Rio de Janeiro). p.549-54 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

A directed flux of gamma-rays produces in an insulating scatterer a Compton electron current, the intensity of which is proportional to the radiation flux. Similarly a directed flux of neutrons produces in a hydrogenated insulating substance a current of recoil protons which is a measure of the neutron flux. A device can be constructed which combines both effects in such a way that it differentiates between neutrons and photons in a gamma-neutron field. The construction of such an instrument and results of measurements are reported. (auth)

26325 OBSERVATION OF SOME EFFECTS OF (n,α) REACTIONS IN GLASSES BY MEASUREMENTS OF DENSITIES, DEFORMATIONS AND STRESSES. J. Paymal, P. le Clerc, M. Bonnaud, and S. de Bonnery (Compagnie de Saint-Gobain, Paris). p.555-66 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In French)

For exposures corresponding to integrated fluxes of the order of 10^{17} to 10^{18} n/cm^2, the effects of neutron irradiation on the density of glasses become appreciable especially with glasses which contain boric anhydride. These effects

are principally attributable to $B^{10}(n,\alpha)$ Li^7 reactions. The extent of variations in the density of glasses of varying composition, exposed in the same conditions of flux, temperature and duration, shows that glasses rich in silica or in lattice-forming oxides generally undergo an increase in density which may reach values of the order of 500×10^{-4} g/cm^3. On the other hand, some glasses rich in modifying oxides, and particularly glasses containing lead oxide, undergo a decrease in density which may amount to 300×10^{-4} g/cm^3. These phenomena can be simply demonstrated by coupling two threads or two plates of glass of different composition together and irradiating the whole. Deformations of these couples then ensure, the extent of which can be used to evaluate the neutron fluxes. By applying heterogeneous irradiation in a specimen of simple geometric form, a system of stresses observable in polarized light can be obtained. Heterogeneity can be obtained with the assistance of partial cadmium screens, for example, using a glass which has a high coefficient of absorption. (auth)

26326 HEALTH PHYSICS DOSIMETRY TECHNIQUES FOR THE CERN ACCELERATORS. B. M. Wheatley (CERN, Geneva). p.571-7 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The wide mass and energy spectra of stray radiation from accelerators are usually unknown. This implies that dosimetry must be based either on "tissue-equivalent" methods, or on spectroscopic studies of the flux from which the absorbed dose may be calculated. Applications and limitations of the two methods are discussed on the basis of experience at CERN with a 600-Mev synchrocyclotron and a 25-Bev proton-synchrotron. The first method requires relatively simple apparatus even for pulsed radiation, and can be made sufficiently sensitive. It is also feasible to make depth-dose studies. However, the method gives no information on the RBE of the radiation so that this factor must be derived from other methods. The second method, that of complete spectral analysis, is inherently difficult. The most promising method seems to be pulse-height analysis with a "tissue-equivalent" proportional counter. The theoretical dosimetry studies, recently extended up to 1 Bev, could profitably be extended to much higher energies. (auth)

26327 THE DOSIMETRY OF HIGH-ENERGY NEUTRONS PRODUCED BY 6.2-GeV PROTONS ACCELERATED IN THE BEVATRON. Roger Wallace, Burton J. Moyer, H. Wade Patterson, Alan R. Smith, and Lloyd D. Stephens (Univ. of California, Berkeley). p.579-88 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The high-energy neutron flux in the stray radiation field surrounding the 6.2-Bev Bevatron is measured by several detector systems. The neutron flux as a function of energy is then converted to rad or rem doses. The high-energy neutrons constitute the biologically most significant component of the radiation field. Several detector schemes in use or being developed are based on the fact that about 6 cm of paraffin surrounding a thermal-neutron detector will render it insensitive to energy and thus allow a flux determination to be made. For instantaneous flux measurements a BF_3 proportional counter is used inside the paraffin jacket. For integrated fluxes In, Co, or Au are used. Threshold detectors of several elements can be used to estimate the neutron spectrum. Polyethylene-lined proportional counters are used in conjunction with the energy-insensitive detectors to allow the average neutron energy at any detector location to be calculated. U^{238} and Bi^{209} fission ion chambers of high sensitivity are used to detect the flux of neutrons with energy greater than 1 Mev and 50 Mev respectively. Nuclear track emulsions are used to measure neutron flux, and recent developments are directed toward employing them for spectral determinations as well. The radiation field intensity and energy distribution in three dimensions as a function of distance from the Bevatron for radiation protection purposes and shielding design will be described. (auth)

26328 DOSIMETER WITH "TISSUE-EQUIVALENT" IONIZATION CHAMBER. F. Humbel and A. Stebler (Landis and Gyr A. G., Zug, Switzerland). p.589-93 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

A complete measuring equipment is described with a "tissue-equivalent" ionization chamber of which the ionization current is determined with a stable d-c amplifier with an oscillating condenser. This equipment permits direct measurement of the dose-rate and, by means of an accessory unit, measurement of the dose. In particular, the characteristics of the ionization chamber with regard to wall material, radiation sensitivity over long periods, reproducibility of the gas filling, and the saturation characteristic are discussed. The accuracy of the measuring method is also dealt with. (auth)

26329 HIGH-LEVEL DOSIMETRY PROBLEMS IN REACTOR OPERATIONS. G. Cowper (Atomic Energy of Canada, Ltd., Chalk River, Ont.). p.595-601 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

In the course of operating an experimental high-power reactor and in processing large quantities of radioisotopes, situations may arise which can result in the overexposure of workers to radiation. Various techniques and methods which are adopted at the Chalk River Laboratories of Atomic Energy of Canada are described. These include an installed radiation alarm system to give warning of an increased radiation hazard in areas having the potentiality for very high radiation levels, and a personal integrating dosimeter which sounds an audible alarm when a predetermined radiation exposure is received. In the operations following an accidental dispersal of radioactive materials, it is desirable to locate the most intense sources of radiation hazard while causing the least radiation exposures to workers. To this end a radiation pin-hole camera is found to have considerable value: it complements the use of a remotely controlled high-range radiation detector, operated from a shielded console. (auth)

26330 DOSIMETRY OF MIXED NEUTRON-GAMMA RADIATIONS IN THE STOCKHOLM REACTOR, R-1. G. Ahnström and L. Ehrenberg (Univ. of Stockholm). p.603-7 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

Radiation doses of fast neutrons and gamma radiation in biological materials and chemical systems were determined in the center of the Stockholm reactor at different degrees of gamma-shielding. The calculation of the neutron dose by integration over the energy spectrum, as estimated by means of threshold indicators, must include also the less well-known epithermal dose. Reasonable agreement was obtained, however, with measurements by ionization chambers (walls and gas with varying hydrogen content), although the latter do not determine a fraction dissipated by slow particles with a high probability of recombination of ions, or which collide elastically with atoms. The dose determinations were supported by measurements of light absorption in irradiated plastics, the thermo-

stable part of the discoloration of which could be proved to be practically independent of type and energy of ionizing particles down to 5-kev deuterons. Further agreement was obtained with calorimetric determinations in hydrogen-free and hydrogen-containing materials. (auth)

26331 CALORIMETRIC DOSIMETRY OF REACTOR RADIATION. A. R. Anderson and J. K. Linacre (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.609-21 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

At Harwell calorimeters are used to measure the total energy absorption in numerous materials irradiated at various positions in the experimental reactors BEPO, DIDO, and PLUTO. This energy is absorbed by three principal mechanisms. The energy absorbed as a result of nuclear reactions may usually be calculated with sufficient accuracy from the basic data available. The energy absorbed from gamma and neutron radiation cannot be calculated absolutely because of the complex gamma and neutron spectra of the reactor radiation. Some simple assumptions about these spectra enable relative rates of energy absorption from each of these mechanisms to be deduced for differing materials, if the energy mass absorption coefficients for gamma radiation and neutron scattering properties are known. Consequently the measured total rates of energy absorption, made in materials having a wide range of mass numbers, may be analyzed to deduce the rate of energy absorption from each mechanism, in any material. An adiabatic calorimeter is used to survey various irradiation holes, and has served to relate rate of energy absorption to reactor power and to neutron-flux distribution. A monitoring calorimeter, which is essentially an isothermal instrument, is being developed to give a continuous indication of the rate of energy absorption during the course of an experiment. These instruments are described. Results obtained using these instruments are presented, and the application of these results to various types of irradiation experiment is discussed. (auth)

26332 GERMANIUM DOSIMETER FOR EVALUATION OF FAST NEUTRON DISTRIBUTION IN THE REACTOR CORE. J. Aleksandrowicz and M. Bartenbach (Inst. of Nuclear Research, Warsaw). p.639-44 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The fast neutron flux geometrical distribution within the core of a water-cooled and water-moderated reactor was measured by means of a germanium detector, taking the changes in electrical conductivity due to radiation damage caused by fast neutrons as a measure of the integral fast neutron flux. This method seems to be a convenient one for quick relative measurements. (auth)

26333 SOME ASPECTS OF DOSIMETRY ON A SPENT FUEL GAMMA-IRRADIATION FACILITY. R. W. Clarke, J. B. Price, and F. Rogers (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.667-72 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

For economical operation of a megacurie spent fuel gamma-irradiation facility it is desirable to simplify the routine dosimetry so that semi-skilled operators can carry out sample irradiations. A careful study of the gamma fields by chemical dosimetry has led to the calibration of ionization chambers which can be used by operators with little scientific knowledge to measure dose-rates. Two such operators with only occasional supervision can successfully irradiate 300 ft^3 of medical supplies to a total dose of 2.5 ± 10% Mrad in a 40-hr week carrying out all packing, rotating and cycling of samples by hand. A cheap visual dosimeter is required for factory inspection. Certain ureaformaldehyde plastics are found to be suitable since they give a readily distinguishable color change for 0.5 Mrad steps up to 2.5 Mrad. The theoretical possibility of the presence of a small photoneutron flux in the spent fuel assembly is investigated to determine the significance of induced radioactivity in irradiated samples. Neutron dosimetry by indium foils has proved adequately sensitive and calculation shows the induced activity to be much less than the activity naturally present. (auth)

26334 IONISATION CHAMBER. Boris Rajewsky. British Patent 871,834. July 5, 1961.

An ionization chamber is described which is sensitive only to certain radiation in mixed radiations and whose current can be adjusted. The chamber comprises two concentric zones separated by a measuring electrode, each zone containing a high-tension electrode. The outer zone also contains a grid and is filled with a gas and provided with suitable walls so that ionization is produced by only one kind of radiation. The inner zone is likewise constructed so that ionization is produced by both the aforesaid radiation and a second kind of radiation. In separating mixed radiations, the current produced by one kind of radiation is canceled by adjusting the grid potential so that only the other kinds of radiation are detected. (D.L.C.)

26335 A METHOD FOR THE MEASUREMENT OF THE DENSITY OF A MEDIUM. (to Institutt for Atomenergi). British Patent 873,816. July 26, 1961.

A method is given for measuring the density or percentage proportion of gaseous and liquid phases of a gas–liquid system, particularly a coolant and/or moderator in a reactor. The method comprises placing a neutron absorbing body in the medium and measuring the neutron flux near the surface of the body. Several variants of this method are described. (D.L.C.)

26336 IMPROVEMENTS IN OR RELATING TO FLOWMETERS FOR FLUIDS. Edward Duncombe and Harold Pugh (to United Kingdom Atomic Energy Authority). British Patent 874,464. Aug. 10, 1961.

A sensitive flowmeter is designed in which fluid flow is measured by rotation of a rotor. (D.L.C.)

26337 IMPROVEMENTS IN OR RELATING TO MASS SPECTROMETERS. John Bishop (to United Kingdom Atomic Energy Authority). British Patent 874,833. Aug. 10, 1961.

A collector head for mass spectrometers is designed for correction of aberration effects. The head comprises a first collector electrode for a first ion beam and having a slot allowing passage of a second ion beam on to a second collector electrode. The first electrode is rotatable while the second electrode is fixed. (D.L.C.)

Materials Testing

26338 (AGN-8024) CENTRIFUGAL CREEP TEST MACHINE EVALUATION PROGRAM. Final Report. (Aerojet-General Nucleonics, San Ramon, Calif.). Dec. 1960. Contract AT(04-3)-251. 130p.

A centrifugal creep test machine was evaluated for in-pile creep use. A large number of specimens (24) can be tested simultaneously in a small physical space at temperatures up to 2000°F and stress levels up to 50,000 psi. Data can be taken without stopping the test. Centrifugal

cantilever bend tests for material screening purposes were conducted on Hastelloy and Inconel materials in a nitrogen atmosphere at 1750°F. Activation energies for creep were obtained from cantilever bend tests on pure aluminum. The same creep laws as in conventional creep-tension were found to apply to creep bending. A centrifugal creep-tension test head was built, and tests were carried out on pure aluminum for comparison with conventional tensile creep and with cantilever bending creep. Cantilever bend specimen profiles were found to be stress dependent. A suggestion is made for testing uniformly bending specimens; their creep is directly interpreted in terms of conventional creep parameters. (auth)

26339 (CF-61-6-67) AN IN-PILE LOOP FOR TESTING CERAMIC FUELS. R. B. Korsmeyer (Oak Ridge National Lab., Tenn.). June 30, 1961. 36p.

A design concept is presented for a small, portable, self-contained, gas-cooled in-pile loop for testing fission product deposition from unclad fuels under temperature and gas flow conditions reasonably close to the design requirements for pebble bed power reactors. The loop is conceived specifically for insertion in either the ORNL-HN-1 beam hole or in the LITR-HB-2 hole, but it can be inserted from the pool side in either the ORR or the BSR. It will fit within the present beam hole liners in the ORR and LITR. The cost of fabricating a loop of this kind was not estimated in the absence of a detailed design. It would appear that the cost should be of the same order of magnitude as the cost of the in-pile loops that were used in connection with the homogeneous reactor program, once a prototype has been successfully shaken down. The incremental cost should be low enough to consider the loops expendable. (auth)

26340 (UCRL-6415) THE HYGE SHOCK TESTER MANUAL. K. W. Volkman (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 21, 1961. Contract W-7405-eng-48. 58p.

The HYGE shock tester is designed to impart a specific force, velocity, or displacement, as a function of time or displacement, to a test specimen. Three HYGE units are described: a 6 in. HYGE with a 12 ft. vertical rail system; a 6 in. HYGE with a 20 ft. vertical rail system; and an 18 in. HYGE with a 69 ft. horizontal rail system. The uses and data evaluation for shock testers are outlined. The operating principles of the HYGE actuators are given, and operating procedures for the HYGE units are detailed. (auth)

26341 (WADD-TR-60-794) A BENCH SCALE METHOD FOR DETERMINING PERFORMANCE CHARACTERISTICS OF LUBRICANTS IN AN OXIDATIVE ENVIRONMENT AT HIGH TEMPERATURES. Samuel B. Schexnailder (Wright Air Development Div. Materials Central, Wright-Patterson AFB, Ohio). Nov. 1960. 31p.

An effective bench scale method for determining physical and chemical characteristics of lubricants subjected to high temperatures in oxidizing environments is described. The apparatus employed is sufficiently simple and economical for even the smallest research facility. However, the methods developed and described are applicable for large scale programs. Data obtained from its use can be readily interpreted to indicate probable performance of experimental fluids and lubricants under the specific conditions used in the screening program. (auth)

26342 (AEC-tr-4772) METHODS OF STUDYING THE THERMAL PROPERTIES OF INSULATORS OF DISPERSED STRUCTURE. A. F. Chudnovskii. Translated for Los Alamos Scientific Lab. from Zhur. Tekh. Fiz., 16: 231-41 (1946). 13p.

The theory of a cylinder-in-cylinder system (two coaxial cylinders) filled with an insulation material is described in detail. Procedures are outlined for determining the thermal properties of insulators using such a system in conjunction with Kondrat'yev's method. Examples of the use of the system are given for quartz sand and clay. (D.L.C.)

26343 (UCRL-Trans-691(L)) STRESS DISTRIBUTION OF A THICK TUBE, SUBJECTING TO AN INTERNAL PRESSURE, WHICH HAS A CROSS SECTION OF REGULAR POLYGON AND A CIRCULAR HOLE IN ITS CENTER. Tatuji Kawaguchi. Translated from Nippon Kikai Gakkai Rombunshu, 18: No. 65, 36-41(1952). 14p. (includes original, 6p.).

A solution of the stress distribution of a thick regular polygonal pipe subjected to internal pressure is derived using an Airy function. Example calculations are given for quadrate and hexagon shaped pipes. It is shown that, where only the maximum stress is required, the polygonal pipe may be substituted by a thick pipe with an outside diameter equal to the inner tangent circle of the polygon. (D.L.C.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

26344 (AD-253702) PROJECT VELA; PROCEEDINGS OF SYMPOSIUM, OCTOBER 1960. (Advanced Research Projects Agency, Washington, D. C.). 332p. (TR 60-6/U)

Eighteen papers are included; separate abstracts have been prepared for twelve. Two papers were previously abstracted in NSA. Project VELA consists of research associated with the detection and identification of nuclear detonations. The scope, present status, and planning of the Project are given along with such topics as the operation and layout of the world-wide standard seismic network, Wichita Mountains Seismological Observatory, and the explosion series to be used in testing equipment. (N.W.R.)

26345 (AD-253702(p.39-75)) DETECTION OF UNDERGROUND EXPLOSIONS. Carl F. Romney (Air Force Technical Applications Center, Washington, D. C.).

Methods of detecting underground explosions, in particular nuclear explosions, are described. Information is given on six underground nuclear explosions ranging in size from 55 tons to 19 kilotons. A detecting system is also described. (N.W.R.)

26346 (AD-253702(p.77-94)) VELA UNIFORM: THE RESEARCH AND EXPLORATORY DEVELOPMENT PROGRAM. Charles C. Bates (Advanced Research Projects Agency, Washington, D. C.).

The research and exploratory development program is outlined in order that breakthroughs resulting in improved techniques can be obtained. A series of simultaneous approaches are used: basic research, exploratory development, systems development, and a carefully monitored research explosion series. Listed are the funds available to various organizations and the projects they are to explore. (N.W.R.)

26347 (AD-253702(p.103-7)) SEISMIC SYSTEMS DEVELOPMENT. Carl F. Romney (Air Force Technical Applications Center, Washington, D. C.).

The developments and progress made in the construction of detection stations for seismic systems are briefly discussed. This discussion covers the following types of stations: Geneva seismic stations, unmanned seismic stations, and a seismological systems laboratory. These stations will be used for equipment development programs and as data processing and transmission centers. (N.W.R.)

26348 (AD-253702(p.123-50)) APPENDIX I: EXCERPT FROM PAGE 16 OF THE REPORT OF THE CONFERENCE OF EXPERTS TO STUDY THE METHODS OF DETECTING VIOLATIONS OF A POSSIBLE AGREEMENT ON THE SUSPENSION OF NUCLEAR TESTS. ([Advanced Research Projects Agency, Washington, D. C.]).

A description is given of the seismometers used for detecting nuclear explosions at a control post. The number of seismometers used in a control post of about 3×3 kilometers located at a place with a minimal level of microseismic background on outcrops of bedrock is also given. (N.W.R.)

26349 (AD-253702(p.151-66)) SOURCE MEASUREMENTS FOR PROJECTS LOLLIPOP AND DRIBBLE. Charles E. Violet (California. Univ., Livermore. Lawrence Radiation Lab.).

The source measurements program for Projects LOLLIPOP and DRIBBLE are presented. Project LOLLIPOP consists of measuring the effects of a nuclear detonation in a granite formation. This test is developed to provide information on the free-field ground motions; that is, motions measured at depths where the reflections at the earth's surface can be separated from the direct waves. The hole and the area are described. Project DRIBBLE is that portion of the seismic program having to do with the study of the decoupling of seismic energy. The nuclear decoupling series will be conducted in a salt dome. A description of the hole, area, and equipment layout is presented. (N.W.R.)

26350 (AD-253702(p.167-75)) SURFACE MEASUREMENTS OF TRANSIENTS FROM EXPLOSIONS IN PROJECT VELA'S EXPERIMENTAL PROGRAM. Joseph W. Berg, Jr. (Advanced Research Projects Agency. Inst. for Defense Analyses, Washington, D. C.).

Station locations for surface measurements of transients from explosions in Project VELA's experimental program are given. The program for the seismic field measurements of the LOLLIPOP shot, which is discussed, is divided into three subdivisions: surface strong-motion measurements and post shot recordings, intermediate range measurements, and long range measurements. The types of instruments used at each location and the function of each station are briefly discussed. (N.W.R.)

26351 (AD-253702(p.177-86)) DECOUPLING OF UNDERGROUND EXPLOSIONS. Albert Latter (RAND Corp., Santa Monica, Calif.).

Decoupling concepts of underground explosions are discussed in relation to the results obtained from Project COWBOY. It is accepted here that the seismic signal is reduced by more than two orders of magnitude where a sufficiently large hole isused for the explosion and the average explosion does not exceed something in the neighborhood of the overburden pressure. (N.W.R.)

26352 (AD-253702(p.201-15)) VELA SIERRA PROGRAM OUTLINE. Donald Chandler (Advanced Research Projects Agency, Washington, D. C.).

The SIERRA portion of the VELA Project has as its objective the development of techniques and equipment to detect and identify high altitude nuclear detonations by ground instrumentation. The phenomena that result from a detonation in distant space is described along with some thoughts on the resulting possibilities for detection. The progress of the program is outlined along with the objectives to be attained. (N.W.R.)

26353 (AD-253702(p.217-31)) RADIO DETECTION OF SPACE NUCLEAR BURSTS. Benson Tucker (Advanced Research Projects Agency. Inst. for Defense Analyses, Washington, D. C.).

The radio modifications caused by a nuclear explosion in space are described. These radio effects are largely caused by a blanket of ionization produced by x rays hitting the upper atmosphere. Results show that the different temperatures that bombs develop make a difference in the altitude of the ionization layer but little difference in the intensity of the ionization. The electron densities of the bombs are additive to the D layer. The newly formed electrons tend to recombine and disappear in the D layer. The detection range of various instruments according to the yield of the explosion and the distance from the earth up to 10^8 km is also given. (N.W.R.)

26354 (AD-253702(p.233-48)) THE APPLICATION OF THE RIOMETER TO NUCLEAR BURST DETECTION. Rolf B. Dyce (Stanford Research Inst., Menlo Park, Calif.).

A riometer is described, and the variations needed to make it applicable for detecting atomic explosions in space are discussed. The purpose of the riometer is to measure any variations in the noise level in the sky. Thus, the riometer makes use of a transmitter already provided by nature. A burst sufficiently above 25 km can be detected if it gives significant x rays in a volume of the D-region which is in view of the riometer antenna. The effect of natural events which might cause false alarms are discussed. (N.W.R.)

26355 (AD-253702(p.249-65)) NASA ENERGETIC PARTICLES PROGRAM. John E. Naugle (National Aeronautics and Space Administration, Washington, D. C.).

A brief summary is given of the NASA Energetic Particles Program for studying the flux, composition, energy spectra, and angular distribution of charged particles near the earth, in interplanetary space, and in the vicinity of the planets and the sun. Some of the experiments are listed. A list of the sounding rockets and space vehicles used in the program is given. Diagrams are presented that show the approximate spectra to be expected, the energy and dynamic ranges of the various particle experiments, and the energy region to be covered with the Ranger payloads. (N.W.R.)

26356 (AD-253702(p.267-86)) BACKGROUND MEASUREMENTS FOR VELA HOTEL. R. Stephen White (California. Univ., Livermore. Lawrence Radiation Lab.).

The need of additional burst background measurements of x rays, γ rays, and charged particles is discussed. A description is given of the types of detectors and associated equipment needed for the detection of nuclear explosions in space. A table is given of the background measurements needed for the VELA HOTEL Program in terms of primary radiation ranges. A summary is also tabularly presented of steady state backgrounds expected in space. (N.W.R.)

26357 (CNI-81) RADIOATTIVITA DEI PRODOTTI DI FISSIONE NEL FALLOUT RACCOLTO DOPO L'ESPLOSIONE NUCLEARE FRANCESE NEL SAHARA. (Radioactivity of Fixed Products in Fallout Collected After the French Test in Sahara). A. Cigna, G. Dominici, A. Malvicini, and L. Vido (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). Apr. 1961. 23p.

For presentation at the VI Reunion of the Italian Association of Health Physics.

The measured radioactivity in fallout collected after the French test in Sahara is described. The activity of short-life radionuclides was determined by chemical separations and gamma spectrometry. The values of the activity of the most important radionuclides in fallout collected at Ispra in March 1960 are reported. (auth)

26358 (SCR-420) PROCEEDINGS OF THE UPPER ATMOSPHERE SAMPLING SYMPOSIUM, HELD AT SANDIA LABORATORY, ALBUQUERQUE, NEW MEXICO, APRIL 11-13, 1961. PART I. J. D. Shreve, Jr., comp. (Sandia Corp., Albuquerque, N. Mex.). July 1961. 180p.

Seventeen papers and discussions are included which were presented at the Upper Atmosphere Sampling Symposium. The symposium centered around the problem of determining the radioactive contamination of the atmosphere. Separate abstracts have been prepared for sixteen of the papers and discussions. (D.L.C.)

26359 (SCR-420(p.17-24)) THE FALL OF SMALL PARTICLES OR HEAVY MOLECULES THROUGH THE UPPER ATMOSPHERE. H. L. Davis and J. R. Banister (Sandia Lab., Albuquerque, N. Mex.).

A one-dimensional model of the upper atmosphere was used to compute the vertical transport of small particles or heavy molecules, taking into consideration both diffusion and gravity. Solutions were derived for particles of mass 150 and 1500 atomic units; it is found that a constant profile is rapidly obtained for any shape of injected profile and that the only effect of diffusion is to keep the profile constant. It is shown that a simple model of layer turbulence does not appreciably affect the profile fall rate. Time vs height curves are presented for particles of mass 150 to 150,000 atomic units. (D.L.C.)

26360 (SCR-420(p.25-39)) ATMOSPHERIC TRACES ABOVE 100,000 FEET. L. Machta and R. J. List (Weather Bureau, Washington, D. C.).

The radioisotopes and their concentrations to be expected at altitudes above 100,000 ft are summarized. The results of some recent lower stratospheric measurements are presented for C^{14}, Sr^{90}, Cs^{137}, Pb^{210}, H^3, Rh^{102}, Be^7, CO_2, and H_2O. (D.L.C.)

26361 (SCR-420(p.41-6)) EFFECTS OF LARGE DIURNAL DENSITY CHANGES ON OUTER ATMOSPHERE CIRCULATION. H. W. Church (Sandia Lab., Albuquerque, N. Mex.).

A simplified model is used to perform approximate calculations on winds caused by diurnal-induced pressure and temperature changes at 660 km. A wind velocity of 4900 km/hr is obtained. Some of the assumptions involved are discussed. (D.L.C.)

26362 (SCR-420(p.47-53)) A HIGH ALTITUDE WIND OBSERVATION FROM NUCLEAR EXPLOSION "TEAK." J. W. Reed (Sandia Lab., Albuquerque, N. Mex.).

Calculations are presented for a debris cloud observation in the Teak explosion on Aug. 1, 1958. The cloud position is determined to be at 1470-km altitude and 2250-km range, and it is concluded that an average southerly wind of 6750 km/hr moved the cloud. (D.L.C.)

26363 (SCR-420(p.55-68)) THE BEHAVIOR OF NUCLEAR DEBRIS FROM THE UPPER ATMOSPHERE ROCKET DETONATIONS AS DETERMINED IN THE HIGH ALTITUDE SAMPLING PROGRAM. J. P. Friend (Isotopes, Inc., Westwood, N. J.).

Sampling of stratospheric dust was carried out at altitudes between 30,000 and 70,000 ft in 1958 to 1960 with U-2 aircraft equipped with duct and impaction probe samplers. Ce^{144}/Sr^{90} ratio vs time plots are presented for the latitude bands 30°N-30°S and 30°N-90°N. Curves illustrating the distribution of nuclear debris in the northern hemisphere are given in terms of W^{185}, Rh^{102}, and Ce^{144}/Sr^{90}, and estimates of the contribution of the Teak and Orange shots are made. The results of aerosol sample studies are presented. Nearly all the aerosol samples appear to contain material from the Teak and Orange shots, and possible explanations of this finding are offered. (D.L.C.)

26364 (SCR-420(p.69-75)) RESULTS FOR THE RHODIUM-102 HIGH ALTITUDE TRACER EXPERIMENT. M. I. Kalkstein (Air Force Cambridge Research Labs., Bedford, Mass.).

About 3 Mc Rh^{102} was produced as a tracer in the Orange shot at 16°N of the Hardtack series on Aug. 11, 1958. Results are presented for samples collected above 19.4-km altitude in both northern and southern latitude regions. A sharp decrease appears in the northern regions in late fall of 1959, coinciding with the time expected for downward mixing in the polar vortex region. Mixing between hemispheres appears to be slow. (D.L.C.)

26365 (SCR-420(p.77-85)) EVIDENCE FOR HIGH STRATOSPHERE HOLDUP OF NUCLEAR BOMB DEBRIS. E. A. Martell (Air Force Cambridge Research Labs., Bedford, Mass.).

Evidence for possible high stratospheric retention of radioactive contamination from past nuclear tests are reviewed. It is concluded that neither sedimentation nor organized circulation of the Brewer-Dobson type is effective in the downward transport of high-altitude debris. Teak and Orange debris, and possibly a large portion of the debris from Ivy, Castle, and other multimegaton tests, were injected into the stratosphere above sampling levels and may still reside there. Direct experimental investigation of residual contamination by high-altitude sampling must be carried out. (D.L.C.)

26366 (SCR-420(p.97-9)) SOME ASPECTS OF THE LASL ROVER FLIGHT SAFETY PROGRAM. L. D. P. King (Los Alamos Scientific Lab., N. Mex.).

The research program for evaluating possible methods of disposal of a rocket reactor and its components on return from orbit or ballistic trajectory is described. Preliminary work indicates that destruction by a nuclear explosion is not promising. (D.L.C.)

26367 (SCR-420(p.101-11)) SAMPLING THE UPPER ATMOSPHERE FOR PARTICULATE MATTER. M. Markels, Jr. (Atlantic Research Corp., Alexandria, Va.).

Two air-sampling methods were analyzed, and the method using a rotorchute sampler was found to be superior to that using a parachute sampler because the blades, moved by air, can be used to move impactors through the air. The impaction particle-collecting method is treated in detail. Some cost estimates are presented for a rocket incorporating the rotorchute sampler with impactors. (D.L.C.)

26368 (SCR-420(p.113-29)) MEASUREMENT OF AIRBORNE RADIOACTIVITY BY GAMMA-RAY SCINTILLATION SPECTROMETRY. P. F. Gustafson (Argonne National Lab., Ill.).

The possibility of using fission product activity in surface air as an index of fallout rate is examined. Air-borne particulates were collected on filters at the Argonne National Lab. site and surrounding area and counted for their gamma activity, and the spectra analyzed for the component isotopes. A graph of the Cs^{137} concentration in surface air from 1953 to 1960 and a graph of W^{181}, Cs^{137}, and Rh^{102} concentrations for Jan. 1958 through Jan. 1961 are presented. Results are given for attempts to separate the activities into components caused by individual nuclear test series, e.g., Hardtack and Soviet October tests. The occurrence of a spring maximum and a fall-winter minimum in the activities and the effect of precipitation on Be^7 concentration in air are discussed. (D.L.C.)

26369 (SCR-420(p.131-4)) A CRYOGENIC AIR-SAMPLING ROCKET. D. F. Burcham and A. M. Haire (Aerolab Development Co., Pasadena, Calif.), and H. E. Karig (National Engineering Science Co., Pasadena, Calif.).

A cryogenic, liquid hydrogen-cooled air sampling rocket is designed for collecting Rh^{102} particles at altitudes above 40 km. Air entering the heat exchanger is either condensed or solidified, and the rocket is returned to earth by a parachute. Some problems involved in the design are discussed. (D.L.C.)

26370 (SCR-420(p.135-48)) THEORY AND PROPOSED EXPERIMENTS FOR STUDY OF DIFFUSIVE COLLECTION. D. Q. Matejka, J. R. Banister, and D. J. Rigali (Sandia Lab., Albuquerque, N. Mex.).

A sampling device for use at 100,000 to 200,000 ft altitudes is described which is shot up by rocket, collects particulate matter with rotating blades, and is floated down by parachute. Some ground facilities for testing the sampler are described. The theory of diffusive collection is discussed, and performance curves are derived for diffusion and impaction on filters. Ground-based testing of the proposed sampling system is discussed. (D.L.C.)

26371 (SCR-420(p.149-58)) SOME RECENT DEVELOPMENTS IN BALLOON-BORNE STRATOSPHERIC SAMPLING SYSTEMS. R. C. Wood (General Mills, Inc., Minneapolis).

Some brief facts on balloons and their load carrying capacity, altitude capability, and cost are outlined. Present sampling methods with a few improvements are described. Some promising new approaches toward increased sampling capability at higher altitudes are discussed. (D.L.C.)

26372 (SCR-420(p.159-63)) SAMPLING PRINCIPLES AND ROCKETS. (Discussion).

A panel discussion on upper atmosphere sampling is presented. Some of the topics covered are: diffusion sampling, gamma spectrometry, balloons, and sample size and distribution. (D.L.C.)

26373 (SCR-420(p.165-71)) SCIENTIFIC IMPLICATIONS OF AN UPPER-ATMOSPHERE SAMPLING SYSTEM. (Discussion).

A panel discussion is presented on technical details of upper atmosphere sampling. Some of the topics covered include mechanical and cryogenic types of samplers, models of stratospheric fall-out, tracers, mixing mechanisms, electromagnetic techniques, impurities in the D-region, detection of detonations in space, and the Vela project. (D.L.C.)

26374 (TID-11101) LETTER PROGRESS REPORT FOR AUGUST 1960 [ON AEROSOLS]. Includes paper: A STUDY OF THE STRATOSPHERIC DISTRIBUTION OF HARDTACK DEBRIS USING THE TRACER, W^{185}. S. C. Stern. Aug. 1, 1960. (General Mills, Inc., Minneapolis). Contract AT(11-1)-401. 33p.

Dual balloon flights were made in July, 1960, to obtain samples of radioactive debris through a cross section of the stratosphere at altitudes of 50, 60, 70, and 80 thousand ft. Procedures and sampling equipment are described. Data are included from a study of the stratospheric distribution of Hardtack debris using W^{185} as a tracer. From a calculated production ratio of W^{185}/Sr^{90} an estimate was made of the Sr^{90} produced by the Hardtack series for 4 stations and several altitudes. It was shown that the debris associated with a specific test series exhibits changes in concentration with time but that the basic cloud may still be essentially intact and identifiable many months after the initial stratospheric injection. At an elevation of 65000 ft a latitudinal decrease in Hardtack Sr^{90} concentrations occurred in the northern hemisphere. This decrease in concentration was attributed to turbulent diffusion and/or mixing of Hardtack debris with older or fresh injections, or the actual removal from the stratosphere of radioactive debris through the jet stream break. (C.H.)

26375 (AEC-tr-4777) SODIUM 22 IN THE METEORITE BREITSCHEID. Else Vilcsek and H. Winke. Translated from Z. Naturforsch., 15a: 1004-7(Nov. 1960). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 9220.

26376 (CEA-tr-A-927) MESURE ET CONTRÔLE DE LA RADIOACTIVITÉ DE L'EAU DE L'ELBE. (Measurement and Control of Radioactivity of the Water of the Elbe).

A. Klein. Translated into French from Wasserwirtschaft, 47: 249-52(1957). 15p.

An apparatus which permits the continuous measurement of activities higher than those considered dangerous for biological material is described. The natural beta activity of the river is measured by evaporating water samples. The results obtained are given. A calibration method using potassium is described. The different measurements relative to the natural activity of the Elbe are made comparable. (tr-auth)

26377 A METHOD OF RADIOACTIVE WELL LOGGING AND A DEVICE FOR ACCOMPLISHING IT. Ya. E. Gorskii. Byull. Izobret., No. 20, 33(1960).

The described method of radioactive well logging with discharge counters is distinguished by the fact that, in order to increase the reliability and steadiness of operation at high temperatures, the voltage fed to the counters is regulated in accordance with the external temperature. The device for accomplishing the method is distinguished by the fact that it is made in the form of a bridge circuit, into two arms of which are connected thermistors and into the other two arms ordinary resistances; to one of the diagonals of the bridge is connected the anode voltage of the well instrument, and to the other diagonal a circuit made up of a high-voltage stabilizer, a discharge counter and the resistance of its load, all connected in series. The high voltage for feeding the counter is fed via the load resistance of a stabilitron to a point between the stabilitron and the counter. (OTS)

26378 THE PRESSURE PULSE PRODUCED BY A LARGE EXPLOSION IN THE ATMOSPHERE. V. H. Weston (Univ. of Michigan, Ann Arbor). Can. J. Phys., 39: 993-1009(July 1961).

The pressure pulse produced by a large explosion in the atmosphere is investigated. The explosion is represented in terms of the excess pressure and normal velocity on a closed surface, outside of which the hydrodynamical equations are linearized. The pulse is represented in terms of a Fourier transform of the associated harmonic frequency problem, for which a ring-source Green's function is obtained in terms of an expansion of the discrete modes. It is shown that the excess pressure may be represented in terms of an integral (containing the Green's function) over the surface surrounding the source. The gravity wave portion of the pressure pulse at the ground is computed for various ranges from the source, which is located at various altitudes, and for three models of the atmosphere. In calculating the head of the pulse a new asymptotic technique is introduced which gives very good results for intermediate and long ranges. (auth)

26379 GAMMA-ACTIVE FALL-OUT IN ONTARIO, 1958-60. K. G. McNeill, O. A. D. Trojan, and D. J. Dawson (Univ. of Toronto). Can. J. Phys., 39: 1010-16(July 1961).

Measurements have been made of the Cs^{137} content of man and of milk and of the Zr^{95} and Cs^{137} activity of airborne dust. They show that the Cs^{137} content of man went through a maximum of 67 $\mu\mu c/g$ K in the fall of 1959, and that the Cs^{137} content of milk reached a low of 7.5 $\mu\mu c/g$ K in September 1960. The results suggest stratospheric and tropospheric residence times of 2 years and 2 months respectively. (auth)

26380 SOME SCIENTIFIC RESULTS OF THE BELGIAN ANTARCTICA EXPEDITION OF 1957-1958. E. Picciotto (Université Libre, Brussels). Ciel et terre, 77: No. 4-5-6, 43p. (Apr.-May-June 1961). (In French)

The geographical environment of the King Baudouin Base is described. The base is situated on the ice-shelf at 10 km from the nearest ice-front. Measurements are made of the air radioactivity, isotopic composition of the precipitations, snow accumulation, and blizzard crystals. An exploration of the Sor Rondane Mountains is discussed in terms of land features and glaciation. These results were obtained in 1958. (N.W.R.)

26381 DIMENSIONAL DISTRIBUTION OF AEROSOL PARTICLES IN THE STRATOSPHERE. Shelton K. Friedlander (Centre National de la Recherche Scientifique, Paris). Compt. rend., 252: 4020-2(June 19, 1961). (In French)

A summary of experimental observations, made by Junge, Chagnon, and Manson (J. Meteor. 18, 81(1961)) has revealed new data on the dimensional distribution of particles at high altitudes (up to 30 km). As in the case of the troposphere, impressive similarities exist in the form of dimension spectra measured at different altitudes and times. A theoretical study is made to explain these similarities. (J.S.R.)

26382 THE ROLE OF PRECIPITATION TREATMENTS IN THE DECONTAMINATION OF A NATURAL WATER WEAKLY POLLUTED BY DISSOLVED RADIO-ELEMENTS. J. Rodier and J. Scheidhauer. Eau, L', 48: 4p.(Apr. 1961). (In French) (CEA-1794)

The decontamination of a natural water by a conventional precipitation treatment was tried. The effects of two reagents, aluminium sulphate and ferric chloride, and the specific elimination of α and β emitters at different contamination levels, are the subject of a statistical study. (auth)

26383 STRATOSPHERIC AEROSOLS. Christian E. Junge, Charles W. Chagnon, and James E. Manson (Air Force Cambridge Research Center, Mass.). J. Meteorol. 18: No. 1, 81-108(Feb. 1961).

A comprehensive study of stratospheric aerosols up to 30 km altitude is presented. Information was obtained on the vertical profiles as a function of particle size, on the size distribution of these particles and on their physical structure and chemical composition. Vertical concentration profiles are considered theoretically on the basis of equilibria between eddy diffusion, sedimentation, subsidence and coagulation. The results are compared with vertical profiles obtained with a recording Aitken nuclei counter which measures the size range of 0.01 to 0.1 microns radius and vertical profiles obtained with impactors over the size range of 0.1 to 1.0 microns radius. The first of these indicates a decrease in concentration from the tropopause to nearly zero at 20 km, whereas the second shows a maximum at about 20 km. The size distributions of these particles were found to be quite constant with time. There is a maximum between 0.01 and 0.1 μ radius, the concentration varying inversely with the square of the radius between 0.1 and 1.0 μ. Very few data could be obtained for particles larger than 1.0 μ because of the low concentration. Large fluctuations seem to be indicated for this size range. The particles between 0.1 and 1.0 μ were found to be very hygroscopic and, by electron microprobe analysis, were found to contain sulfur as a major constituent, with traces of iron and silicon. Thus, those smaller than 0.1 μ are of tropospheric origin. Those between 0.1 and 1.0 μ are the most likely formed within the stratosphere, possibly by oxidation of SO_2 and H_2S gas traces. Fall speed considerations make it very likely that the majority of particles larger than one micron are of extra-terrestrial origin. (auth)

26384 COMPARISON OF BERYLLIUM-7 AND CESIUM-137 RADIOACTIVITY IN GROUND-LEVEL AIR. P. F. Gustafson, M. A. Kerrigan, and S. S. Brar (Argonne National Lab., Ill.). Nature, 191: 454-6(July 29, 1961).

The difference in behavior between Be^{7}, formed at a constant rate by cosmic ray interactions with atmospheric constituents throughout the entire atmosphere, and Cs^{137} from stratospheric fall-out is examined as an indication of the transport of debris from the stratosphere into the troposphere. The effect of precipitation, seasonal variation, elevation of the tropopause, and uniformity of rate of stratospheric removal are discussed. (C.H.)

26385 GEOCHEMISTRY OF RADIOACTIVE ELEMENTS IN THE OCEAN AND THE CHRONOLOGY OF DEEP-SEA SEDIMENTS. Edgard E. Picciotto (Université Libre, Brussels). p.367-90 of "Oceanography." Mary Sears, ed. Washington, D. C., American Association for the Advancement of Science, 1961.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 11331.

HEALTH AND SAFETY

26386 (AFSWC-TN-58-3) AIRCRAFT ACCIDENTS INVOLVING PLUTONIUM CONTAMINATION. Thomas P. Baker, Jr., Bruce B. Boecker, and James L. Dick (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). May 12, 1958. 16p.

Procedures are presented for the delineation and subsequent control and cleanup of an area contaminated by an aircraft accident involving plutonium contamination. The area of concern will be that of an area contaminated by plutonium to 1000 micrograms per square meter and/or 1000 disintegrations per minute per cubic meter of air or greater. This area will be contained within approximately 400 feet radius for one weapon, 550 radius for two weapons, 650 feet radius for three weapons, etc. (auth)

26387 (AHSB(S)R-4) LECTURES ON CRITICALITY. E. D. Pendlebury, E. R. Woodcock, A. F. Thomas, K. D. B. Johnson, and C. M. Nicholls (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch, Risley, Lancs, England). Nov. 23, 1960. 99p.

Included is a collection of lectures which deal with: nuclear constants; theoretical considerations for the behavior of neutrons in matter and criteria for critical size, the factors affecting criticality, interaction and storage, and transport containers; criticality problems with metal systems; chemical aspects of criticality; and chemical plant design for criticality safety. (B.O.G.)

26388 (ANL-6367) RADIOLOGICAL SURVEY OF THE HEALTH DIVISION DIAGNOSTIC X-RAY FACILITY. A. G. Januska and W. H. Smith (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 17p.

Results are reported from a radiological survey of the diagnostic x-ray facility to determine the levels of exposures encountered in scattering under normal operating conditions. A survey was made of the air dosages received by operating personnel and those undergoing diagnostic study. The results indicate that, the exposures received by operating and subject personnel do not approach permissible levels recommended as maximum by the National Committee on Radiation Protection. (C.H.)

26389 (ARF-1158A01-5) RADIATION STREAMING IN SHELTER ENTRANCEWAYS. Final Report. C. W. Terrell and A. J. Jerri (Illinois Inst. of Tech., Chicago. Armour Research Foundation). July 1961. Contract NBy-3185. 113p.

An analytical and experimental investigation was conducted of nuclear radiation streaming in ducts and shelter entranceways. The energy dependence of duct attenuation was extended for gamma rays. Further duct geometry dependence was measured. Thermal neutron attenuation was determined for a non-point source and the neutron attenuation was found to be extremely small. Use of albedo theory to successfully describe the radiation streaming of gamma rays was further strengthened and a computer code was prepared to describe the streaming in a straight duct. The code represents a tremendous labor saving device for future calculations. An analytical analysis of a straight duct, using albedo theory, is included in the appendix along with an outline of future research needs. (auth)

26390 (CEA-1925) PROTECTION DES TRAVAUX DANS LE CAISSON DE LA PILE G.2. (Protection for Work in the Pressure Tank of the Pile G2). J.-Ph. Chassany and J. Rodier (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 29p.

While the pile was shut down after a three-month run at full power, the secondary circuit was cleaned and some alterations were carried out. The pile contained 100 tons of uranium, half of which made up the periphery and was irradiated uranium. The possibility of carrying on work inside the pressure tank was not considered at the time of construction. Because of the heat and the radiation it was only possible to remain in the pressure tank for a limited period of time, and several operators received doses of the order of 1.5 rem. Cotton clothing gave satisfactory protection against contamination and was more comfortable than the vinyl equipment. The work lasted for 17 days and involved 881 incursions into the pressure tank. (auth)

26391 (GNEC-184) ECNG-FWCNG PROJECT. COMPUTER PROGRAM FOR LOSS-OF-COOLANT ACCIDENT STUDIES. (General Nuclear Engineering Corp., Dunedin, Fla.). June 1, 1961. 151p.

A computer program was written to predict the transient behavior of the ECNG-FWCNG (Florida Power Reactor) in hypothetical loss-of-coolant accidents. A complete description of the program is presented. (J.R.D.)

26392 (HW-38759) ATMOSPHERIC CONTAMINATION ASSOCIATED WITH INERT-GAS-SHIELDED. CONSUMABLE ELECTRODE ARC WELDING. F. E. Adley and W. E. Gill (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 25, 1955. Contract AT(45-1)-1350. 7p.

Concentrations of atmospheric contamination which were reported to be associated with an inert-gas-shielded consumable electrode arc welding operation were studied to evaluate the potential health hazards. It was concluded that ozone and metal fume produced in this operation require control. An exhaust booth with an air velocity at the enclosure opening of 150 feet/min in which welding can be done is recommended. (J.R.D.)

26393 (HW-66539) GENERAL LIMITS FOR THE STORAGE OF ENRICHED URANIUM METAL. R. E. Tiller (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 18, 1960. Contract AT(45-1)-1350. 6p.

Conservative storage requirements are calculated for U fuel elements with enrichments up to 5 wt.% U^{235}. A table is given of the maximum weights of U in containers, and minimum separations between containers, as functions of the U enrichments. Guides are also given for finding requirements for U storage in water. (T.F.H.)

26394 (HW-70085) THE USE OF AQUEOUS FOAM TO CONTROL CONTAMINATION DURING UNDERGROUND BURIAL OF FAILED EQUIPMENT. D. A. Snyder (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 26, 1961. 6p.

A scheme is described for controlling contamination while failed contaminated equipment is being buried. In this scheme, an aqueous foam is pumped into a light-frame container containing the equipment in a burial trench, the contaminated air from within the box is displaced through a filter, and backfilling is commenced. A comparison of burial costs with and without foam is presented. Applications of the scheme to burial of Purex and Redox equipment are described. (D.L.C.)

26395 (NADC-MA-6039) THE HEALTH HAZARDS OF RADIOACTIVATED MATERIALS IN NUCLEAR POWERED

SEAPLANES. Final Report. John W. Taylor, Elizabeth Reeves, and Emma I. Fessenden (Naval Air Development Center, Aviation Medical Acceleration Lab., Johnsville, Penna.). Dec. 31, 1960. 24p.

The general health hazards of a nuclear powered aircraft are discussed. Emphasis is placed on the problem of ingesting particulate material. Dust samples were collected from operational P5M seaplanes and results extrapolated to an assumed nuclear aircraft. The dusts were studied using microscopy to determine gross particulate nature, x-ray diffraction to determine molecular constituents and particle size below one micron, and activation analysis to determine individual nuclides that become radioactive under neutron bombardment. These results indicate that no special problem exists in connection with the occupied areas of a seaplane. Sodium was not found to be a major constituent and little additional hazard results from operation in a salt water environments. (auth)

26396 (ORNL-3086) CALCULATED TRANSIENT PRESSURES DUE TO IMPULSE AND RAMP PERTURBATIONS TO VENTILATING SYSTEMS IN BUILDINGS 3019, 3026, 3508, AND 4507. J. J. Perona, W. E. Dunn, and H. F. Johnson (Oak Ridge National Lab., Tenn.). Aug. 15, 1961. Contract W-7405-eng-26. 63p.

As part of a general hazard review survey conducted by the Chemical Technology Division of its facilities, transient pressures due to impulse and ramp perturbations to the cell ventilating systems of buildings 3019, 3026, and 4607 and the closed glove box system of 3508 were calculated. From the portions of the pressure curves above atmospheric pressure, volumes of gas outleakage were estimated; thus the amount of activity released can be calculated if an estimate of the activity concentration is available. The volumes of outleakage for all four ventilating systems were small for reasonable sizes of perturbations. For an impulse perturbation causing an instantaneous rise of +8.0 in. H_2O, the length of time above atmospheric pressure and estimated outleakages for PRFP cells in 3019 are 1.5 sec and 3.1 ft^3, respectively; for volatility cell 1 in 3019, 0.33 sec and 0.45 ft^3; for cell A in 3026, 2.1 sec and 3.0 ft^3; for a glove box in 3508, 0.066 sec and 0.04 ft^3; and a cell in 4507, 0.26 sec and 0.03 ft^3. (auth)

26397 (ORNL-3159) APPLIED HEALTH PHYSICS ANNUAL REPORT FOR 1960. (Oak Ridge National Lab., Tenn.). July 27, 1961. Contract W-7405-eng-26. 47p.

Although there were the usual fluctuations in background at certain of the monitoring stations, the contamination levels recorded do not differ significantly from those of the previous year except that there appears to be a slight trend downward. Data are tabulated. This downward trend can be attributed to a curtailment of operations at the Laboratory, the gradual implementation of the containment program, and a curtailment in world-wide weapons testing. Fall-out data are included. Two personnel exposures were recorded which have been reported elsewhere. One employee received a relatively high exposure to the left hand which consisted primarily of soft radiation. A second employee apparently has accumulated a sizeable fraction of a permissible body burden of Pu^{239}. The number of unusual occurrences increased over the previous year. However, in general, these events posed only routine problems and it is probable that the noted increase in such occurrences is due primarily to a more complete reporting system which was inaugurated early in the year. (auth)

26398 (TID-12994) THE MEASUREMENT OF ENVIRONMENTAL RADIATION. Annual Report. (New York Univ., New York. Graduate School of Arts and Sciences). June 1, 1961. Contract AT(30-1)-1704. 46p.

Efforts were made to determine the composition and energy spectrum of the environmental radiation, particularly of the ultra-soft component. A thin-wall environmental chamber is now in operation, and a technique for measuring the electronic spectrum is under development. The thick-wall chamber remained in continuous operation, providing data on unusual environmental effects, such as are associated with precipitation and solar flares. Studies were continued on electron attachment and recombination, both fundamental processes in the operation of gas detectors, especially low-voltage ion chambers. The construction and operation of the automatic monitoring system is described. A study of the columnar effects associated with densely ionizing radiation such as α particles, with particular emphasis on evaluating the Jaffe-Zanstra theory of columnar recombination, is discussed. (M.C.G.)

26399 (AEC-tr-4482(p.38-50)) AREAS FOR HANDLING RADIOACTIVITY AND SAFETY PRECAUTIONS. M. Nakaizumi.

Safety precautions in the handling of radioactivity are outlined. The viewpoint of the medical and biological profession, the technical measures for the application of these viewpoints, and the past and present status of national administration and controls are discussed. Maximum allowable and lethal doses of radiation are described. The amount of mutation was found to be proportional to the sum of the accumulated doses. Examination of staff members working in radioactive operation areas is discussed. (M.C.G.)

26400 (AEC-tr-4482(p.462-74)) STUDIES ON THE DECONTAMINATION OF RADIOACTIVE SUBSTANCES USING SOILS OF THE MONTMORIN SERIES. Y. Yamada and M. Miyaguchi.

The decontamination of fission products of medium or lower level activity by using the ion absorption and fixation ability of soils of the Montmorin series was studied. The effects of coexisting salts on the absorption were determined. The change of the amount of absorption of Cs^{137} in the presence and absence of Illite was studied. The fixation of radioactive substances by heat treatment of the soil was investigated. After absorbing fission products for 2 hr, the soils were heated to 500, 750, and 1050°C for 11 hr, followed by elution with a 3% NaCl solution. The amount eluted increased with time for 50 hr, but no more elution was observed after 50 hr. No vaporization occurred with the heat treatment. Decontamination or radioactive substances was also carried out by passing them through a column of the soil. (M.C.G.)

26401 (AEC-tr-4482(p.666-81)) CONTAMINATION BY RADIOACTIVE MATERIALS AND ITS REMOVAL. T. Miura and Y. Ishida.

An investigation was made of various materials with a possibility of being used for floors, desks, and instruments in order to determine their contamination by radioactive materials and methods for decontamination. The materials studied included wood, clothing, metal plates, bricks, slates, mortar, glass, vinyl sheets, rubber, leather, and the painted surfaces of these materials. Contamination of porous surfaces by aqueous solutions was determined by the ability of the surface to absorb water. Definite correlation existed among different solutes. In the case of nonporous surfaces there was no correlation of decontamination index and contamination factor among different solutes. Correlation to water-repellancy was not discovered. A

high degree of inverse proportionality existed between the contamination factor and the decontamination index. Decontamination by dissolving the contaminants had a certain limit. In this case the greater part of the removable contaminants was removed by the first washing in water or by a few rubbing strokes. Any further repetition of the operation did not cause much progress. When a piece of wood which was contaminated and then dried came in contact with water, the contamination spread toward the interior. Among the materials difficult to contaminate but easy to decontaminate were stainless steel, vinyl sheets, glass, rubber, and surfaces covered with paint. Decontamination was complete when strippable paints were used. When pigments were added to paints, the rate of contamination was generally increased. (M.C.G.)

26402 (CEA-tr-A-922) PROBLÈME DE SÉCURITÉ ET DE PROTECTION POSES PAR LA CONSTRUCTION DES RÉACTEURS NUCLÉAIRES ET LA MANIPULATION DES ISOTOPES RADIOACTIFS. (Problems of Safety and Protection in Construction of Nuclear Reactors and Handling of Radioactive Isotopes. VII). E. G. Graul (Gravl). Translated into French from Atompraxis 5: 434-43(1959). 68p.

The expression "health physics" is submitted to a critical analysis, and health physics is studied statistically. The essential aspects of radiation protection, as well as the economics of the protection, are emphasized. (tr-auth)

26403 A NEW PHANTOM MATERIAL EMPLOYING DEPOLYMERISED NATURAL RUBBER. A. J. Stacey (Royal Cancer Hospital, London), A. R. Bevan, and C. W. Dickens. Brit. J. Radiol., 34: 510-15(Aug. 1961).

Two fluid natural rubber compounds are described which are suitable for use as phantom materials in the photon energy range 30 kev to 4 Mev. One sets to a firm rubber on heating for 1.5 to 3 hrs at 100°C, with an attendant linear shrinkage of about 1.5%, while the other becomes solid at room temperature in 10 to 14 days with very little shrinkage. The adjustment of the absorption and scattering coefficients is discussed and some uses of the compounds are indicated. (auth)

26404 ELIMINATION OF ASHING IN THE DETERMINATION OF STRONTIUM AND CALCIUM IN LIQUID MILK. John R. Brown, Anita A. Jarvis, and Bella Tiefenbach (Univ. of Toronto). Can. J. Biochem. and Physiol., 39: 1309-12(Aug. 1961).

A non-ashing analytical procedure for the determination of Ca and Sr in liquid milk is described. Milk was mixed in bulk with Dowex resin, stirred at 78°C, and Ca and Sr eluted from the resin using 6 N HCl. The Ca was determined using a buffered oxalate precipitation procedure, followed by the modified Kramer-Tisdall method. Strontium was analyzed using flame spectrophotometry. An average of 79.4% of added Sr was recovered using the non-ashing technique. The method has not been tried on the determination of other radionuclides at the present time. (auth)

26405 EFFECT OF TROPOSPHERIC JET CURRENT ON THE STRATOSPHERIC FALL-OUT OF RADIOACTIVE PARTICLES: ON A POSSIBLE VERTICAL TRANSFER MECHANISM OF STRATOSPHERIC AIR MASSES. Georges Barbé (Établissement d'Études et de Recherches de la Météorologie Nationale, Magny-les-Hameaux, France). Compt. rend., 252: 3620-2(June 5, 1961). (In French)

The fall of radioactive particles from the high stratosphere to ground level is much faster than would be expected from the effects of gravity alone. In the present work, the action in the middle and high stratosphere of a vertical transfer mechanism for the radioactive debris is shown experimentally. It is shown that the circulation of air in a plane perpendicular to the axis of a jet can be compared with two cells (the tropospheric one bounded at the top in the vicinity of the horizontal plane containing the axis of the jet tube, and the stratospheric one bounded at the bottom by this same horizontal plane). The existence of the ascending branch of the tropospheric cell is confirmed by the privileged localization of "cloud streets." (J.S.R.)

26406 NATURAL RADIOACTIVITY IN TOBACCO AND TOBACCO SMOKE. V. C. Runeckles (Imperial Tobacco Co. of Canada, Ltd., Montreal). Nature, 191: 322-5(July 22, 1961).

Measurements were made of the natural radioactivity in cigarette tobacco, ash, and main-stream smoke. The observed level in smoke was compared with figures obtained by calculations on K^{40} content. Results are tabulated and compared with measurements on daily dietary K^{40} intake and data on the fate of particles in the respiratory tract. It was concluded that the observed activity of cigarette main-stream smoke is due almost entirely to K^{40}, and that the amounts of this activity taken into the lung by even the heavy smoker are minute when compared with the bodily uptake from the diet. The radioactivity was found to be rapidly eliminated from the lung tissue. The possibilities are discounted that the natural activity of cigarette smoke is a cause of lung cancer and that the level of radioactivity in cigarette smoke is so high that it may be considered a radioactive material. (C.H.)

26407 RADIOCESIUM AND POTASSIUM IN NORWEGIANS. Johan Baarli (Norwegian Radium Hospital, Oslo), Kjell Madshus, Kurt Lidén, and Richard C. McCall. Nature, 191: 436-8(July 29, 1961).

Results are presented from whole-body measurements of Cs^{137} and K in a group of people, together with the approximate daily consumption of milk and pure goats' cheese. Estimates of the body burden of Cs^{137} due to a daily intake of 50 gm of pure goats' cheese gave a value for total-body irradiation of 0.38 mr/week or 20 mr/year. (C.H.)

26408 THE GENETIC RADIATION CHARGE OF THE POPULATION BY MEDICAL APPLICATION OF IONIZING RADIATIONS. H. Holthusen. Umschau Fortschr. Wiss. u. Tech., 61: 366-7(June 15, 1961). (In German)

The results of statistical evaluations of the genetic radiation charge of the populations of Hamburg, Germany, Switzerland, and England are briefly reported. (J.S.R.)

26409 DOSIMETRY REQUIREMENTS FOR PROTECTION FROM IONIZING RADIATION. K. Z. Morgan (Oak Ridge National Lab., Tenn.). p.3-23 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The recommended levels of maximum permissible exposure were decreased by an order of magnitude within the past decade, and this decrease has added to the difficulties of obtaining appropriate dose measurements and of maintaining adequate dosimetry records. In order to meet the requirements for both routine and accident dosimetry, personnel meters should cover a range of about 10^5 (i.e., from 30 mrad to 3,000 rad), and building and area survey meters should have a range of about 10^8 (i.e., from 10^{-5} rad/hr to 10^3 rad/hr). The only acceptable criterion of exposure to ionizing radiation is the one which furnishes evidence that the RBE dose to the various organs of the body from all sources of ionizing radiation has not exceeded the limits

specified by the International Commission on Radiological Protection. The organ dose from external sources can be calculated from dose measurements made outside the body and from a knowledge of the energy spectrum and angular distribution of each type of ionizing radiation. Internal dose can be estimated from the levels of radioactive contamination in the food, air, and water taken into the body; from the levels of radioactive contamination in the urine, faeces, and exhaled air; from direct measurements with whole-body counters; and from indirect measurements using small dosimeters placed in test animals and in phantoms. (auth)

26410 RADIATION PROTECTION IN INDUSTRY. A. Savouyaud, M. Diéval, and H. Rigaut (Centre d'Etudes Nucléaires, Saclay, France). p.25-32 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In French)

Description is given of the general principles applicable in laboratories or plants processing radioactive materials, including monitoring and dosimetry of exposure to ionizing radiation, and monitoring of contamination of surfaces, fluids, and personnel. The apparatus developed for the above purposes is described. Examples are given of equipment for use in the various types of laboratory to be monitored (nature and quantity of the equipment required). (auth)

26411 ESTIMATES OF ENERGY DISSIPATION BY HEAVY CHARGED PARTICLES IN TISSUE. J. Neufeld and W. S. Snyder (Oak Ridge National Lab., Tenn.). p.35-44 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The International Commission on Radiological Protection (ICRP) has recommended that the relative biological effectiveness (RBE) of ionizing radiation be based on linear energy transfer (LET). The stopping power of various ions in tissue is calculated and is based on extensive new measurements. The average charge of a moving ion is determined on the basis of data summarized by Neufeld and the average square charge is calculated by taking into account several recent measurements on the equilibrium charge distribution of heavy ions as a function of energy in the range from 6 to 26 Mev. The specific ionization is determined by means of recent measurements on the stopping power of protons in the energy range 20 to 250 kev and the experimental data on the average charge of a proton for various velocities. The LET for tissue is represented as a summation of terms representing individual contributions of the LET values corresponding to various components of tissue. The new values that are obtained indicate higher LET values for heavy charged particles than those indicated in the earlier calculation. Perhaps the new results emphasize the great need for an accurate physical means of estimating LET and the almost total absence of information concerning the biological effects of radiations having a high rate of energy transfer. It would be a fundamental advance in our knowledge of dosimetry to verify directly the influence of these higher values on biological systems of interest. (auth)

26412 PRESENT STATUS OF STANDARDIZATION OF EXPOSURE DOSE IN JAPAN. M. Naito, Y. Inoue, Y. Ibaraki, and Y. Moriuchi (Electrotechnical Lab., Tokyo). p.45-52 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

In order to maintain the national standard of exposure dose in Japan, the Electrotechnical Laboratory, Agency of Industrial Science and Technology, is equipped with two primary standard ionization chambers (for medium energy and soft x-rays), and three secondary ones (for medium and hard x-rays). The characteristics (especially the accuracy) of the exposure-dose measurement of the primary standard chamber for the energy region from 40 to 300 kvp are described. This chamber is a parallel plate, free air type, with guard plates. The error in the exposure-dose measurement by the primary standard chamber is not more than ± 1%, if all the examined factors act in the same direction and the null method with a potentiometer is used, and ± 3% if the vibrating reed electrometer is used as a direct detector of the ionization current. (auth)

26413 DOSE RATE AND THE TIME FACTOR. K. K. Aglintsev. p.79-83 of "Selected Topics in Radiation Dosimetry." Vienna. International Atomic Energy Agency, 1961. (In Russian)

A method is developed for solving the problem of recovery under irradiation, using the concept of the organism's radiation memory. The initial value of the radiation memory of irradiation over a short period is assumed to be equal to the dose for that period. The phenomenon of the recovery process is regarded as a gradual fading of the radiation memory with time. It is suggested that fading of the radiation memory occurs in accordance with an exponential law, the values of the exponents being calculated as $\frac{1}{3}$, $\frac{1}{2}$, 1, 2, and 3. The absence of recovery is taken to indicate that the value of the radiation memory remains unchanged. The biological effect of irradiation is regarded as proportional to the total values of the radiation memory for the period of irradiation and not to the dose absorbed by the organism. The correlation between the biologically significant dose and the absorbed dose for continuous and pulsed irradiation is given, with different relationships between the duration of irradiation, the interval between successive pulses, and the duration of the recovery process. (auth)

26414 AN APPROACH TO RELEVANT DOSE COMPUTATIONS FROM ENVIRONMENTAL CONTAMINATION. K. A. Mahmoud. p.85-99 of "Selected Topics in Radiation Dosimetry." Vienna. International Atomic Energy Agency, 1961. (In English)

In order to avoid getting the distribution in time of environmental contamination from peaceful uses of atomic energy involved with its future predicted dose, the use of an arbitrary increment of contaminating deposit ΔP in a short increment of time Δt is suggested as a basis of dose computations. The question is approached of the assumptions and the relevant parameters that must be taken into account for the computations of the infinite time integral doses relevant to the genetic and somatic effects due to gamma- and beta-emitting fission products delivered to different human organs from such an increment of environmental contamination. A similar but simpler computation is also suggested for C^{14} injected in the atmosphere and the relevant infinite time integral dose delivered to human organs is assessed. (auth)

26415 THE CUSTOMARY METHOD IN GERMANY FOR PERSONNEL MONITORING BY FILM BADGES. F. Wachsmann (Universität, Erlangen, Ger.). p.275-83 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The film badges employed have several filters made of the same material (copper), which enables the quality of the radiation to be easily determined. Each film badge contains two films in a single packet, one having a high sensitivity, the other a low sensitivity. These films permit the evaluation of doses of a few mr to about 1,000 r and the

detection of x-rays and gamma radiation from about 5 kev up to many Mev and high-speed electrons and beta rays from about 100 kev upwards. Details of the methods carried out with the aid of film badges and finger-rings are given together with the results of statistical evaluation. Finally, the combined badges for measuring thermal neutrons (film blackening) and fast neutrons (nuclear emulsion films) are also mentioned. (auth)

26416 ESTIMATION OF DOSE DISTRIBUTION WITHIN THE BODY FROM EXPOSURES TO A CRITICALITY ACCIDENT. W. S. Snyder (Oak Ridge National Lab., Tenn.). p.647-56 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

An adequate system of dosimetry for exposures due to a critical excursion must provide information from which the dose received by the different body organs can be obtained. In order to use proper RBE factors the dose from gamma-rays should be estimated separately from the dose received from protons and heavy recoil atoms. Thus it is essential to know the energy spectrum of neutrons incident on the body, but since the gamma-rays are quite penetrating and have an RBE of 1, it usually suffices to know the air dose of gamma radiation. Under laboratory conditions the air dose of gamma radiation can be measured by an ion chamber and the neutron air dose can be obtained by the use of a specially designed and operated proportional counter. The neutron spectrum can be determined approximately by the use of the Hurst threshold detectors. In the case of critical accidents the neutron spectrum and the gamma dose can be estimated if threshold detectors and metaphosphate glass dosimeters are located near the site. If the exposed person wears a dosimeter belt containing gold, sulfur and glass dosimeters, his orientation can be taken into account. By normalization with the fixed dosimeters, this allows for an estimate of the dose distribution within his body. In case some or all of the components of this system are missing, a re-run of the excursion may be necessary. This need not be at the exact power level of the accident, since the data can then be normalized with the sodium activation observed in the blood of the exposed person. The spectrum of neutron and gamma radiation from the critical assembly can also be calculated. Monte Carlo calculations are performed to determine the dose distribution in a cylindrical tissue mass equivalent to the trunk of the human body for various neutron energies. Using the data mentioned above, these results make it possible to determine the dose pattern in the body of an exposed person. (auth)

26417 CALCULATION OF THE RADIATION YIELD FROM FISSION ASSEMBLIES AND COMPARISON WITH EXPERIMENTS. R. H. Ritchie (Oak Ridge National Lab., Tenn.), H. B. Eldridge, and V. E. Anderson. p.657-66 of "Selected Topics in Radiation Dosimetry." Vienna, International Atomic Energy Agency, 1961. (In English)

The quantities D_n/A and D_γ/D_n may be determined experimentally by exposing a phantom to a mock-up of the critical assembly and measuring activation simultaneously with the neutron and gamma doses received by the phantom. Alternatively, if the spectra of neutrons and gammas incident upon the individual are known, D_n/A and D_γ/C_n may be obtained by calculation. An experimental monitoring system is devised for use in areas in which a critical accident is possible. This system may be used to obtain data from which estimates of D_n/A and D_γ/D_n may be inferred after the occurrence of a nuclear excursion. Calculation from first principles of the number-energy spectra of gamma-rays and neutrons which might be involved in such an accident is desirable. The computation of neutron leakage spectra from some typical bare critical assemblies is carried out using existing multigroup reactor codes. The gamma leakage dose is calculated by means of special machine codes using the gamma source distribution predicted by the multigroup codes as input data. It is found that data obtained from the experimental monitoring system may be interpreted quite easily when one deals with fast and intermediate reactor systems. In the case of thermal systems, the monitoring method is still useful, but will require more care in the interpretation of the experimental data so obtained. Results of the computations are compared with experimental data on D_n/A and D_γ/D_n. (auth)

26418 UNSEALED RADIOACTIVE SUBSTANCES REGULATIONS, FACTORIES ACTS, 1937-1959. Preliminary Draft of Regulations. (Gt. Brit. Ministry of Labour, London). 1961. 29p.

A preliminary draft of regulations dealing with the use of unsealed radioactive substances in industry is presented. Included are calculation methods, maximum permissible contamination levels, and maximum permissible radiation doses. (J.R.D.)

26419 METHOD AND DEVICE FOR THE NEUTRALIZATION OF RADIOACTIVE SOURCES, ESPECIALLY ACCIDENTAL RADIOACTIVE SOURCES. (to Société Industrielle pour l'Exploitation de Robinetteries Spéciales). French Patent 1,229,023. Mar. 21, 1960.

Accidental radioactive sources are neutralized by covering them with a light shield consisting of a mixture of B and silica gel, and/or a heavy shield consisting of a mixture of graphite and Pb powder. The shields are applied by means of gas pressure from two containers placed on a car which are provided with telescopic spouts. (NPO)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

26420 (NYO-9040) THE POTENTIAL APPLICATIONS OF RADIOISOTOPE TECHNOLOGY TO WATER RESOURCE INVESTIGATIONS AND UTILIZATION. Final Report. Herbert W. Feely, Alan Walton, Charles R. Barnett, and Fernando Bazan (Isotopes, Inc., Westwood, N. J.). Apr. 3, 1961. Contract AT(30-1)-2477. 352p.

A review is made of past work on the application of radionuclear techniques to research in water resources and supply. Suggestions are made concerning the directions which future work on these applications should take. The fields discussed include the use of radionuclear techniques in the chemical, physical, and biological analysis of water, in the tracing of surface water and subsurface water, including soil moisture, in the treatment and tracing of domestic and industrial water supplies and wastes, and in the tracing of sediment. Special attention is given to the use of tritium and natural carbon-14 for tracing water and to the use of neutron absorption and neutron activation of stable tracers in water. The use of chelates to stabilize radionuclear tracers in solution is also discussed. To supplement the references, an annotated bibliography of relevant books and technical papers is presented. (auth)

26421 (AEC-tr-4482) PROCEEDINGS OF THE SECOND JAPAN CONFERENCE ON RADIOISOTOPES, FEBRUARY 1958. Translated from a publication of the Japan Atomic Industrial Forum, Inc., Tokyo, 1958. 1731p.

Proceedings of the Second Japan Conference on Radioisotopes are presented. One hundred and thirty papers are included. Separate abstracts were prepared for 121 of the papers. (M.C.G.)

26422 (AEC-tr-4482(p.29-37)) UTILIZATION OF RADIOISOTOPES IN THE CHEMICAL INDUSTRY IN JAPAN. T. Saito.

Utilization of radioisotopes in research and industrial applications including the chemical field amount to only 10% of the total use of radioisotopes in Japan. This utilization is compared with that in the United States and England. Methods in which radioisotopes can be used are outlined. Uses of isotopes for liquid level control, thickness gages, density gages, testing of finished products, production process analysis, and as a source of radiation are discussed. The use of strong source irradiation devices in Japan is surveyed. The problems of prevention of radiation hazards are outlined. (M.C.G.)

26423 (AEC-tr-4482(p.51-8)) AN APPLICATION OF BETA-RAYS FOR THE ELIMINATION OF ELECTROSTATIC CHARGE ON TEXTILE MATERIALS. K. Nishioka.

In order to remove the electrostatic charge generated on fabrics in the course of their processing, a device was developed which uses the ionizing effects of beta radiation. Three methods were examined: the case of the roller having 4 sources in groves 90° apart, the case of the roller having 8 sources in groves 45° apart, and the case in which one of the sources was placed at a point immediately above the point the material left the roller. The efficiency of the removal of the electrostatic charge was estimated by means of plotting the induced voltage against the time lapse after the starting of the motor driving the roller. For the same isotope, the larger the intensity of the source or the larger the number of sources, the greater was the effect of the removal. With low roller speeds the efficiency of the charge removal was greater when one of the sources was external. (M.C.G.)

26424 (AEC-tr-4482(p.150-60)) NONDESTRUCTIVE INSPECTION OF WELDED JOINT OF BOILER DRUM WITH RADIOISOTOPES. G. Ito.

Examples of gamma radiography using radioisotopes to inspect the welded joints of boiler drums for use in ships and in other applications from the point of view of quality control are discussed. As an example, the welded joints of a tanker of 32,800 tons were considered. Standards for radiation transmission pictures of welded joints are suggested. (M.C.G.)

26425 (AEC-tr-4482(p.161-71)) GAMMA-RAY RADIOGRAPHY OF LIGHT ALLOYS USING Tm^{170}. M. Kato, M. Kobayashi, and W. Seki.

The properties of Tm^{170} and the use of this isotope in the gamma radiography of light alloys are discussed. Using various kinds of Al and Mg alloys as samples, and Tm^{170} as a source of radiation, an exposure chart of various kinds of x-ray film was prepared to determine the degree of sensitivity of fluorescent and lead foil sensitized papers and their ability to record defects. It was found that the thickness which gives a difference in density of 0.02 is the minimum size of defect that can be detected by this method. (M.C.G.)

26426 (AEC-tr-4482(p.192-205)) ABSORPTION OF GAMMA-RAYS IN STEEL: A CONSIDERATION FOR RADIOGRAPHY. R. Fuji and Y. Maruyama.

Gamma absorption in steel was studied in connection with radiography. Attention was directed to the scattered gamma radiation in connection with the exposure table and the build-up factor, as well as on the integrated intensity of the gamma radiation in order to obtain the necessary graduation of picture. The effects of absorber and slit arrangement on the gamma attenuation were determined. Absorption curves were determined under various conditions. (M.C.G.)

26427 (AEC-tr-4482(p.206-19)) MEASUREMENT OF FLOW IN PENSTOCK USING RADIOISOTOPES. I. Otsuka, T. Goto, S. Kuwahara, I. Tako, and C. Onishi.

The water flow in a medium-sized hydroelectric power plant was measured by Piteau's method and the radioisotope method. Na^{24} and Co^{60} were used in the isotope method. A comparison of the data indicated that the value given by the isotope method is somewhat larger than that given by Piteau's method. However, since the number of measurements using the radioisotope method was small and the center of gravity method with the counting rate-time curves were not fully investigated, it could not be concluded that the value given by the radioisotope method is always larger than that given by Piteau's method. (M.C.G.)

26428 (AEC-tr-4482(p.220-35)) STUDY OF THE MECHANISM OF METAL WEAR BY USE OF RADIOISOTOPES. T. Sata.

Radioisotopes were used for analysis of wear phenomena. Testing samples were electroplated with Zn^{65}, and the samples were used to investigate the microscopic structure of wear, the effects of the coarseness of the rubbing surfaces, and the effects of lubricants. Wear experiments were per-

formed by rubbing a spherical testing sample electroplated with Zn^{65} against flat testing samples of carburized steel. It was found that the amount of wear of the order of 10^{-6} grams can be detected by the measurement of radioactivity, and the wear product particle of the order of 10^{-9} grams can be detected by autoradiograph. There was a considerable fluctuation in the particle size in wear. Lubrication reduced both the size and number of the wear particles. (M.C.G.)

26429 (AEC-tr-4482(p.236-51)) RESEARCH ON ENGINE WEAR BY USE OF RADIOACTIVE TRACERS: PISTON RINGS ACTIVATED BY DEUTERON BOMBARDMENT. M. Kato, S. Tsutano, Y. Takai, and A. Umehara.

An investigation was made of wear on piston rings activated by deuteron bombardment. The distribution and thickness of the activated layers were determined. X-ray films and stripping type films were used to obtain autoradiographs, and the thin-layer distribution of radioactivity was confirmed. The thickness of the layers was determined to be from 250 to 300 microns. It was thus found that 80 to 90% of the free path of deuterons in iron participated in the nuclear reaction. Radioisotopes which were produced in the deuteron reactions were chiefly Mn^{54}, Co^{56}, and Co^{57}. The piston rings were dissolved in HCl, and the amount of reduction of the outer surface was computed on the basis of the measurement of the decrease in weight. (M.C.G.)

26430 (AEC-tr-4482(p.252-60)) STUDY OF THE FLOW OF MOLTEN METAL IN A REVERBERATORY FURNACE FOR COPPER. K. Manabe and T. Takegawa.

Radioisotopes were used to investigate the process of melting, reducing, and refining copper in a small oil-burning reverberatory furnace. The isotopes Au^{198} and Ag^{110m} were used. The flow of the molten metal was determined on the basis of observation of the time-dependent variation of radioactivity at various positions. The average speed of flow of the molten metals was from about 100 to 300 mm/min. when the burner was stopped. After the elapse of one hour, the radioactivity was approximately the same at all positions, indicating that the molten metals were well mixed. (M.C.G.)

26431 (AEC-tr-4482(p.261-75)) RESEARCH ON THE ELECTROLYSIS OF TABLE SALT BY APPLICATION OF RADIOISOTOPES. S. Mizuno, S. Toshima, and O. Furukawa.

Radioisotopes were used in research on the electrolysis of table salt by the mercurial method. Hg^{203} was used as a tracer to measure the speed of the electrolytic migration of mercury in the presence of Na^+ ions by means of a precision counting rate meter and an automatic recorder. The relationship between the phenomenon of the migration of cathode mercury and the cathode potential. The results were compared to the curves for current vs. potential. The same treatment was given to H^+ ions, and the speed of electrolytic migration as well as the mode of migration was determined. The same treatment was given to the impurities in the electrolysis of salt such as Mg^{2+} and Ni^{2+}. The relationship between the electric field gradient and the speed of the electrolytic migration was clarified. It was found that the migration of the cathode mercury in the presence of Na^+ and H^+ is caused by the discharge of the ions alone. (M.C.G.)

26432 (AEC-tr-4482(p.276-90)) BEHAVIOR OF SULFUR IN BUTYL RUBBER. K. Yokose, H. Kakimoto, and T. Arai.

A tracing experiment was performed with S^{35} to investigate the dispersion and behavior of a small quantity of sulfur in the mechanism of vulcanization. Autoradiographs were taken from the samples after the removal of uncombined sulfur, which remains in the vulcanized sulfur without interaction. Results revealed that the amount of sulfur being removed decreased as the vulcanization progressed. The relationship to the amount of uncombined sulfur which was determined by chemical analysis was established. It was also confirmed that the solution made of equal parts of oleic acid and naphtha will remove not only metallic oxides but also metallic sulfide. (M.C.G.)

26433 (AEC-tr-4482(p.291-305)) UTILIZATION OF RADIOISOTOPES IN THE ANALYSIS OF PRODUCTION PROCESSES IN CHEMICAL PLANTS. C. Kumura, I. Adachi, and N. Okada.

Radioisotopes were used to study the processes in the production of alumina by the Bayer method. P^{32} was used as the tracer. Measurements were made of the surface level in pressurized tanks. The reactions in the solutions and the behavior of suspended particles were traced. (M.C.G.)

26434 (AEC-tr-4482(p.306-19)) EXAMPLES OF THE APPLICATION OF RADIOISOTOPES IN CHEMICAL PLANTS. S. Sonoda, T. Hirayama, and K. Hamada.

The uses of radioisotopes in analyses of the production processes in chemical plants are discussed. Measurements were made of the speed and distribution of flow of the solution trickling down filled towers in the production of dilute H_2SO_4. P^{32} was used as the tracer. Analyses were made of flow in solutions in the electrolytic tanks for the electrolysis of KCl. P^{32} in the form of H_3PO_4 was used as the tracer. Evidence was obtained of the presence of at least three passages of flow within each tank. Methods of tracing iron in the production processes of morundum are discussed. The iron in the raw material bauxite was labeled by irradiation of the sample to distinguish it from the scrap iron added. The efficiency of the magnetic separation and scrubbing in acid was determined. At each stage of the operations, the total iron content of the samples was determined by chemical analysis and the radioactivity was measured. (M.C.G.)

26435 (AEC-tr-4482(p.320-34)) MERCURY SHUTTER TYPE Co^{60} GAMMA-RAY IRRADIATOR FOR INDUSTRIAL USE. S. Wada, C. Kobayashi, and K. Baba.

A gamma source for industrial use with a shutter mechanism using mercury is described. The Co^{60} irradiation source is a capsule which is immersed in mercury in a box. The capsule is supported by a vertically movable axis. The outside of the mercury box is surrounded by lead as a shield. The advantages of the mercury shutter and problems caused by using mercury are discussed. The necessary devices for safety in the operation of the source are described. (M.C.G.)

26436 (AEC-tr-4482(p.399-403)) IMPROVEMENT OF DYEING PROPERTY OF SYNTHETIC FIBERS BY IRRADIATION. S. Onishi.

Graft polymerization by irradiation was carried out and the dyeing properties of the graft fibers produced were investigated. A vinyl acetate monomer was irradiated. The free radicals formed acted as initiators for polymerization and the vinyl acetate was grafted on to synthetic fibers. The fibers thus obtained were saponified by a NaOH solution. The samples were then dyed and their durability in washing investigated. An improvement of the dyeing properties was observed. (M.C.G.)

26437 (AEC-tr-4482(p.451-61)) APPLICATION OF C-14 TO THE MEASUREMENT OF THE PRODUCTIVITY OF LAKES AND SWAMPS. H. Saijo and T. Ichimura.

The use of C^{14} for the determination of productivity in lakes and swamps was studied and the results compared with those obtained by the method of determination based on the change of dissolved oxygen in water. Water containing vegetative plankton or pure chlorella culture were poured into two groups of bottles and sodium carbonate solution containing C^{14} was added. One bottle was exposed to a light source for 3 to 6 hr or more and filtered. The radioactivity on the filter paper was measured. The amount of the CO_2 assimilated by the vegetative plankton was calculated. Change of dissolved oxygen in bright and dark conditions was determined in parallel with the C^{14} method. The amounts of photosynthesis in pure culture of chlorella and in the natural water of the lakes were determined. With a high light intensity, the results of the C^{14} method agreed with the net productivity obtained by the dissolved oxygen method. With weak light, some differences were observed and the dissolved oxygen method showed a lower value. (M.C.G.)

26438 (AEC-tr-4482(p.610-18)) DESIGN OF A MEDIUM LEVEL RADIOISOTOPE TRACER LABORATORY. T. Arakawa.

A radioisotope laboratory for tracer application, preparation of labeled fertilizer and for preliminary experiments leading to factory scale experiments is described. Types and amount of radioisotopes being used, site, plan of layouts, ventilation and heating equipment, illumination, plumbing and wiring, drainage, experimental equipment, storage equipment, air exhaust, and waste material disposal are discussed. (M.C.G.)

26439 (AEC-tr-4482(p.619-27)) CONSTRUCTION OF RADIOISOTOPE HANDLING LABORATORY. T. Hamada and M. Okano.

A laboratory designed for the distribution of radioisotopes is described. The principle of the design, the structure of the laboratory, the equipment in each standard unit, the distribution of ventilation, and the finishing materials for the building interior and equipment are discussed. (M.C.G.)

26440 (AEC-tr-4482(p.628-44)) RADIOISOTOPE LABORATORY FACILITIES AT SHOWA ELECTRIC MANUFACTURING COMPANY. S. Sonoda, T. Shigeki, and A. Matsumoto.

The radioisotope laboratory described is divided into the main divisions of tracer research facilities and irradiation application facilities. Installation of fixed facilities was avoided as much as possible in order to provide flexibility of arrangement of equipment to meet the individual objectives of the experiments. Descriptions of all the equipment are included. (M.C.G.)

26441 (AEC-tr-4482(p.645-53)) A BASIC PLAN FOR A GENERAL RADIOISOTOPE LABORATORY. M. Fujii.

A basic plan for a general radioisotope laboratory is described. The facilities include an irradiation room, operation room, hot cave, instrument operation laboratory, applied chemistry laboratory, materials testing laboratory, fertilizer testing preparation room, distribution room, storage room, measurement laboratory, synthesizing laboratory, tracer laboratory, green house, health control room, dispensary, clinic and waiting room, x-ray room, examination room, Van de Graaff room, betatron room, preparatory operation room, and dark room. Ventilation, air-conditioning, drainage, and disposal of wastes are discussed. (M.C.G.)

26442 (AEC-tr-4482(p.654-65)) TOH-SHIBA HOT LABORATORY. R. Kitani and M. Terada.

Laboratory facilities in which the operation of installing radioactive sources in instruments and research on the change of properties by gamma irradiation can be safely performed are described. A labyrinth system was adopted for shielding the entrance of the cave. Shielding was provided by ordinary concrete of 2.35 density, but heavy reenforcements were used locally in order to provide additional shielding. The hot cell and remote control manipulator, the shielding door, and an electric car for operation in the cell are described. (M.C.G.)

26443 (AEC-tr-4482(p.743-50)) DETECTION OF LATENT FINGERPRINTS BY RADIOACTIVE MATERIALS. T. Takeuchi, Y. Sakaguchi, Y. Nakamoto, and M. Motogusa.

An attempt was made to detect latent fingerprints by using the photographic action of radioactive compounds. Three methods in the use of radioactive substances were considered: replacement by radioactive compound of the specific substance contained within latent fingerprints; fixation of the specific substance in latent fingerprints by radioactive substances through chemical reaction; and adhesion or absorption of radioactive substances to materials in the latent fingerprints. With respect to the first method, an attempt was made to replace Cl^- in NaCl which is contained in the cutaneous secretion by contact with HCl^{35}. For the second method, a chemical reaction was produced between protein and formaldehyde-C^{14}. For the last method, an attempt was made to use the adhesive reaction produced by steric acid-C^{14}. It was found possible to get images by autoradiography with two methods: formaldehyde and steric acid. (M.C.G.)

26444 (AEC-tr-4482(p.1319-29)) STERILIZATION BY THE USE OF Co^{60} GAMMA RAY–STERILIZATION OF AQUEOUS INJECTION. T. Chitani and T. Takahashi.

The sterilization of aqueous injections using gamma radiation from Co^{60} was investigated. First, water, the main component of the injection, was contaminated by Bacillus subtilis and Escherichia coli, and then sterilized by gamma radiation. The relationship between total dose and dose rate was studied. Aqueous solutions of vitamins C and B_1 were irradiated and studies of the relationship between their recovery and total dose and dose rate were made. Results indicated that the total dose required for sterilization was greatly affected by dose rate. In the case of contamination with Bacillus subtilis and Escherichia coli, the lower the dose rate, the smaller the amount of total dose necessary for sterilization. It was also found that the decomposition of vitamins C and B_1 was proportional to the total dose, and was indifferent to the dose rate. (M.C.G.)

26445 EFFECT OF RADIATION PASTEURIZATION ON THE STORAGE LIFE AND ACCEPTABILITY OF SOME NORTH ATLANTIC FISH. Joseph H. Carver and Maynard A. Steinberg. Com. Fisheries Rev., 21: No. 10, 1-6(Oct. 1959).

Screening studies were performed on raw and on blanched cod, pollock, whiting, and butterfish and on raw flounder irradiated at pasteurization doses ranging from 116,500 to 1,860,000 rads. Although some samples were acceptable when irradiated at the higher dosage level, those samples that were irradiated at levels of 465,000 rads and lower have greater acceptability. Storage life studies at 35°F were performed on raw and on blanched cod fillets, dressed butterfish, and on raw pollock that was irradiated at levels of 232,500 and 465,000 rads. In addition, raw pollock was irradiated at a level of 930,000 rads. The storage life extension of the irradiated fish over that of the unirradiated fish stored at the same temperatures was as follows: butterfish–about three times; cod–about two times; and

pollock—no appreciable increase. Blanching did not increase the storage life or improve the acceptability of irradiated butterfish and cod. Deep-fat frying considerably increased the acceptability of raw, irradiated cod and pollock. (auth)

26446 IRRADIATION PRESERVATION OF PACIFIC NORTHWEST FISH. I. COD FILLETS. David T. Miyauchi (Bureau of Commercial Fisheries, Seattle). Food Technol., 14: 379-82(1960).

Pacific cod fillets were irradiated at various dosage levels from 0 to 1.86 megarads to determine their initial acceptability and storage characteristics at refrigerated temperatures of 32 to 35°F. The optimum irradiation dose for cod fillets appeared to be 0.46 megarad or lower. Irradiation at these low dosage levels increased the storage life of cod fillets at 32 to 35°F by about three times. The objective freshness tests investigated, including determinations for total volatile base, total volatile acid, trimethylamine, and plate counts, were not a reliable index of quality. (auth)

26447 IRRADIATION PRESERVATION OF PACIFIC NORTHWEST FISH. PRECOOKED FISH STICKS. David T. Miyauchi (Bureau of Commercial Fisheries, Seattle). Food Technol., 14: 411(1960).

Two temperatures were chosen, room temperature and 35°F, to determine the storage life of precooked breaded fish sticks irradiated at doses up to 2.0 megarads. The storage characteristics at room temperature of the fish sticks were poor, and the storage life at 35°F of fish packed in cans was about 8 to 12 weeks. The bacteria counts on the fish sticks are presented in tables. Although the results of the study are negative, they indicate the limitations of low level irradiation of precooked fish sticks. (P.C.H.)

26448 THE FIRST POLISH ATOMIC LAMP. Tudomány és Tech., No. 23, 716(1960).

The lamp's main part is a small hollow body with krypton-85 radioactive gas; it contains luminophore filaments illuminated by means of energy obtained through gas radiation. The test lamp light could be observed over a distance of as much as 300 m. The lamp preserves its illuminating power during a period of 10 years and burns at half power during several decades. Its use is harmless to the human organism. (OTS)

ISOTOPE SEPARATION

26449 (K-1483) EQUILIBRIUM TIME FOR SQUARE PLANTS WITH ONE INFINITE RESERVOIR. D. W. Burton (Oak Ridge Gaseous Diffusion Plant, Tenn.). Aug. 14, 1961. Contract W-7405-eng-26. 61p.

Tabulated values of equilibrium time for square cascades with one infinite reservoir are presented. It is a continuation of Report K-1330 which contains equilibrium times for finite reservoirs only. (auth)

26450 (AEC-tr-4396) EXPERIMENTS FOR THE SEPARATION OF ISOTOPES ACCORDING TO THE METHOD GIVEN BY G. HERTZ. Herbert Harmsen. Translated for Oak Ridge Gaseous Diffusion Plant from Z. Physik, 82: 589-609(1933). 33p.

A plant for separating neon isotopes according to G. Hertz's method is described. The method makes use of the diffusion of the isotope mixture through porous walls into a vacuum; the gas flows through narrow clay pipes around whose external sides a vacuum is maintained by means of mercury vapor pumps. Two consecutive clay pipes are denoted as a separation unit, and the plant utilized consisted of 24 such units. By using the process once, a change of the concentration ratio of neon isotopes 20 and 22 by a factor of about 40 is attained. A practically complete separation of neon isotopes is attained by repeated utilization; the two fractions contain no more than 1% of the other isotope. (N.W.R.)

26451 (AEC-tr-4752) EQUIPMENT FOR THE SEPARATION OF ISOTOPES IN THE GASEOUS PHASE BY MEANS OF ISOTOPE TRAPS. Inventors: Kurt Diebner, Erich Bagge, and Karl-Friedrich Leisinger. Translated for Oak Ridge Gaseous Diffusion Plant from German Patent No. 1,058,024, May 27, 1959. 7p.

An isotope trap is described that separates isotopes in the gaseous phase by periodically opening and closing a system of intermittent diaphragms. This equipment and method applies to those gases that can be condensed to the temperature of liquid air or solid carbon dioxide. The equipment is characterized by the face that cold traps and/or pump lines are installed in the space between the rotating diaphragms. The rotating diaphragms are spatially fixed and are opened and closed electrically or magnetically. The rotating diaphragms are driven externally by a disk or tube in a magnetic or magnetoelectrical manner or by a shaft. The separating space between the rotating disks is sealed with labyrinth packings with respect to the supply and storage chambers. (N.W.R.)

26452 (AEC-tr-4779) ISOTOPE SEPARATION. A. Klemm. Translated by Kurt H. Quasebarth for Univ. of Virginia from excerpt of Atomwirtschaft, 3: 341-2(1958). 5p. (EP-4422-506-61U)

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 16546.

26453 THE CONCENTRATION OF THORIUM ISOTOPES IN THE WATERS OF THE AZOV SEA. D. S. Nikolaev, K. F. Lazarev, and S. M. Graschenko. Doklady Akad. Nauk S.S.S.R., 138: 674-6(May 21, 1961). (In Russian)

It was found that the concentration of thorium in the waters of the Azov Sea varied within wide limits from 4×10^{-9} g/l for the open, wide part of the sea to 219×10^{-9} g/l at the point where the river Don empties into the Azov Sea. The concentration of thorium in the water depends on the amount of suspended matter, and on the climatic conditions and place of sample selection. The water near the shore contains more suspended matter, and hence, is higher in thorium. The ratio of RdTh/Th was found to be 1.43 by extracting the thorium in a composite sample with tributylphosphate from nitric acid solution, and separating polonium from thorium on an anion exchanger. The RdTh content in this sample was determined by an emanation method from the growing in of ThX. The Th content was also determined on the composite sample. UX_1 was used to correct for yield. (TTT)

26454 SEPARATION OF BORON ISOTOPES. V. THE PHENOL-BF_3 SYSTEM. A. A. Palko (Oak Ridge National Lab., Tenn.), J. S. Drury, and W. E. Bull. J. Chem. Phys., 35: 103-5(July 1961).

The exchange of boron between BF_3(g) and BF_3.phenol (l) was studied. The single-stage isotopic fractionation factor varied according to the equation, $\log \alpha = (10.315/T) - 0.02423$, over the temperature range −8°C to 37°C. B^{10} is concentrated in the liquid phase. Vapor pressure measurements of dilute and concentrated solutions of BF_3 in phenol were made at various temperatures from −10°C to 40°C. The freezing point of the BF_3.phenol complex was approximately −15°C; that for the BF_3.2 phenol, −5°C. (auth)

26455 ENRICHMENT OF THE ^{6}Li-ISOTOPE IN DEKAGRAM QUANTITIES BY ELECTROMIGRATION IN MOLTEN LITHIUM CHLORIDE. M. M. Benarie (Scientific Dept., Ministry of Defence, Tel-Aviv, Israel). J. Inorg. & Nuclear Chem., 18: 32-41(Mar. 1961). (In English)

While the enrichment of small quantities of the Li^6 isotope by electromigration appears relatively simple, the cathodic chlorination of the lithium and the regeneration of lithium chloride causes difficulties in continuous operation and in the separation of larger quantities. The introduction of the hollow graphite cathode which functions as a saturated chlorine cathode eliminates this difficulty. With the simple and inexpensive apparatus described, the method gives a satisfactory enrichment and easily reproducible results. (auth)

26456 COMBINED PROCESS FOR THE PRODUCTION OF WATER ENRICHED WITH DEUTERIUM AND THE SYNTHESIS OF AMMONIA. (to Friedrich Uhde G.m.b.H.). British Patent 870,452. June 14, 1961.

A process is given for the combined production of enriched water and ammonia. The process involves isotope exchange between ammonia and hydrogen, resulting in enriched ammonia which may be burned to form nitric oxide and enriched water. An installation for carrying out the process is described. (D.L.C.)

26457 ULTRACENTRIFUGE FOR THE CONTINUOUS SEPARATION OF A GASEOUS MIXTURE INTO TWO COMPONENTS. (to Reactor Centrum Nederland). French Patent 1,224,098. Feb. 8, 1960.

A tubular ultracentrifuge is described. The height is more than three times its diameter. It rotates and oscillates like a top. For that purpose the centrifuge is provided with a bottom pivot which rests on a flexibly mounted support. The centrifuge is held in its vertical position by means of an axial magnetic field generated between a first annular magnetic body which is fixed at the top of the centrifuge and a second annular magnetic body which is flexibly mounted on the housing of the centrifuge. The centrifuge is brought into rotation by means of an electromagnetic

motor, the rotor of which is fixed on the pivot. The centrifuge is provided at its top with axially mounted coaxial inlet and outlet tubes, while discharge openings for the heavy component are provided near the bottom. (NPO)

26458 METHOD OF ISOTOPE SEPARATION. (to M. G. H. Girodin). French Patent 1,240,085. July 25, 1960.

Isotope separation processes are offered in which a reciprocal diffusion is effected between a gas, e.g. UF_6, and an auxiliary gas, e.g. Ar. The two gases are either countercurrently fed on either side of a diffusion barrier or countercurrently fed into a low speed tubular centrifuge. The effluxes are separated into the two constituent gases by freezing. (NPO)

MATHEMATICS AND COMPUTERS

26459 (AERE-M-898) DATA REQUIREMENTS FOR THE 1960 VERSION OF STAB. A. R. Curtis, J. G. Tyror, and H. E. Wrigley (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England and United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). June 1961. 28p.

Revised and Declassified Version of AERE-M-476.

An account is given of the data required for the current (1960-61) version of STAB, the three-dimensional reactor kinetic program, and of the method of preparation. An imaginary example is given. (auth)

26460 (CF-61-7-88) POWER TRACE ANALYSIS CODES, SNAVELY AND PIP FOR THE IBM-7090. M. L. Tobias, D. R. Vondy, T. B. Fowler, and M. P. Lietzke (Oak Ridge National Lab., Tenn.). July 31, 1961. 13p.

Two programs were prepared for the purpose of obtaining objective statistical information concerning the HRT power trace. The PIP code was used to obtain frequency distributions of power peaks. The SNAVELY program computed the reactivity additions necessary to account for the observed power fluctuations. Frequency distributions were calculated concerning the size and rate of these additions. The behavior of fluid recirculation rates, variation in which could lead to reactivity changes, was also computed. Provision was made for calculating Fourier series coefficients in order to discover periodicities. Input to these programs consists of reactor power data obtained at equal time intervals. The calculation speed is sufficiently high that over 20,000 values of the power may be processed in a reasonably short time (10 to 15 minutes). (auth)

26461 (DP-597) IBM 650 ROUTINE VII PRESSURE DROP IN CHANNELS WITH BOILING. James C. Jensen (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1961. Contract AT(07-2)-1. 27p.

A computer program was developed for the IBM 650 to calculate the pressure drop and density distribution in heated channels in which boiling occurs. (auth)

26462 (HW-68862) A TABLE TO FACILITATE THE CALCULATION OF LIKELIHOOD RATIO TEST STATISTICS FOR HYPOTHESES CONCERNING GROUPED DATA. W. L. Nicholson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT(45-1)-1350. 34p.

The tables of $f(N) = 2N \log N$, $N = 1(1)5000$ computed on an IBM 7090, is rounded off to three decimal places. An example of application of the tables to several sample problems is included. (J.R.D.)

26463 (JAERI-6006) OUTLINE OF ANALOG COMPUTER AND COMPUTING METHOD. Reference Document No. 6. (Japan Atomic Energy Research Inst., Tokyo). Mar. 1961. 89p. (In Japanese)

An outline of an analog computer and computing method is presented. The composition, operational elements, major elements other than operational elements, operation of the computer, and processes prior to operation of the computer are described. Examples of calculations given include kinetics of water boiler reactors, analysis of control of British-type power reactor, and solutions to higher order algebraic equations. Symbols for connection diagram of operational elements, examples of basic operational circuits, input and output circuits of operational amplifier, signal selector, method of fixing diode function generator, performance of operational elements, precautions in operation of a computer, methods of rate test, and principle of operation with operational amplifier are described. (M.C.G.)

26464 (ORNL-3150) WHIRLAWAY—A THREE-DIMENSIONAL, TWO-GROUP NEUTRON DIFFUSION CODE FOR THE IBM 7090 COMPUTER. T. B. Fowler and M. L. Tobias (Oak Ridge National Lab., Tenn.). Aug. 15, 1961. Contract W-7405-eng-26. 30p.

WHIRLAWAY is an IBM 7090 FORTRAN programmed code for the solution of two-group neutron diffusion equations in xyz geometry. The code was designed to run under control of the IBM 7090 FORTRAN Monitor System on a machine with at least six tape units. The maximum number of mesh points is limited to 12,750. Arbitrary distributions of materials and mesh spacing are permitted. The boundary conditions are either zero flux or zero current at each of the six faces of the reactor, and the code will, if desired, compute the adjoint-flux and associated flux-adjoint-flux region integrals that are necessary for perturbation calculations. Computation time is approximately 0.006 sec per point iteration. Normally, running times are about 2 to 3 hr for a 10,000-point problem. (auth)

26465 (AEC-tr-4503) CONSTRUCTIVE THEORY OF FUNCTIONS. I. P. Natanson. Translated from a Publication of the State Publishing House of Technical-Theoretical Literature, Moscow-Leningrad, 1949. 572p.

Issued in two books.

A detailed and clear exposition is presented on the constructive theory of functions, a branch of mathematical analysis engaged in problems of approximate representation of arbitrary functions. The exposition is divided into three parts dealing with uniform approximation, quadratic approximations, and interpolation and mechanical quadratures. (D.L.C.)

26466 (NP-tr-640) (DESCRIPTIVE TITLE) BROCHURES ON ELECTRONIC COMPUTERS AND INSTRUMENTS. Translated by J. Slep from a publication of the Central Bureau of Technical Information, Moscow. 142p.

A catalog is presented which gives descriptions of mathematical computers and instruments. Included are groups of related equipment which include general application analog computers and auxiliary equipment, digital computers, recorders, infrared instruments, and calculating machines for operating systems. (J.R.D.)

26467 FORMULATION OF STATISTICAL MECHANICS IN TERMS OF OCCUPATION NUMBERS. [PART] I. Roger Balian, Claude Bloch, and Cyrano de Dominicis (Centre d'Etudes Nucléaires, Saclay, France). Nuclear Phys., 25: 529-67(1961). (In French)

The perturbation expansions of the Gibbs potential and the propagators at finite temperature are put into a new form by means of an algebraic theorem on creation and annihilation operators. The new diagrams are made of subdiagrams having exactly the same structure as the ground state diagrams (the "anomalous" diagrams having disappeared). These subdiagrams play a part analogous to the self-energy insertions in field theory, and their explicit summation can be carried out in a time-dependent formulation. It leads to the replacement in the expansions of the unperturbed statistical factors f_m^- by new factors F_m^- which

can be interpreted as the true occupation numbers. A general argument based on the topological structure of the diagrams shows that the expansion thus obtained for the Gibbs potential is stationary with respect to variations of the F_m. The formulation presented here leads to an elimination of the activity e^{α}. It appears therefore as a generalization of the classical virial expansion. (auth)

26468 THE USE OF LINEAR GRAPHS IN GAUSS ELIMINATIONS. S. Parter (Cornell Univ., Ithaca, N. Y. and Brookhaven National Lab., Upton, N. Y.). SIAM (Soc. Ind. Appl. Math.) Rev., 3: No. 2, 119-30(Apr. 1961). (BNL-4341)

A procedure to study the effect of "sparseness" in Gauss elimination and to choose an elimination scheme if practical is introduced. The associations between graphs and matrices are developed and illustrated, and properties of special graphs, the trees, are discussed. The occasional breakdown of the Gauss procedure is also illustrated. (L.N.N.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

26469 (ANL-6080) SCALE-UP OF HIGH-PURITY URANIUM PRODUCTION. Final Report—Metallurgy Programs 1.1.11 and 2.1.7. G. B. O'Keeffe (Argonne National Lab., Ill.). June 1961. Contract W-31-109-eng-38. 41p.

Routine production techniques and equipment developed to supply high-purity uranium in sufficient quantities to meet the needs of diversified research programs are described. Also, information is presented with regard to process efficiency, operational difficulties, and ingot production. Typical analyses are given for the cast ingots. (auth)

26470 (BMI-1518(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MAY 1961. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). June 1, 1961. Contract W-7405-eng-92. 95p.

The first in-pile Zircaloy-2 creep experiment was started. Data on stressing are given and typical thermocouple data are included along with preliminary creep data. Results of a study on cast Nb–Pu–Si alloys for high temperature propulsion uses are included. Microscopic studies of PuO_2 compatibility continued with examination of specimens containing Nb, Ti, and V. Results of irradiation of several metastable beta-phase U alloys are tabulated. Data from thermal-conductivity measurements were completed on UN–20 vol % Mo cermet. Melts of smaller UC skulls to achieve better control of the C composition were conducted, and data on the mechanical and physical properties of UC are tabulated along with data on self diffusion in these carbides. Results of bench-scale tests on removal of Cd from zinc sulfate electrolyte are tabulated. A study of site formation in polybutylmethacrylates was continued. Measurements of thermal and electric conductivity of irradiated and unirradiated UO_2 are given. Nickel alloys were investigated for use in the HAPO fused-chloride electrolytic fuel recovery process. Surface area measurements are reported on four different batches of UO_2 powder having a similar particle size. Burnup analyses of U^{235} in fueled graphite spheres were completed. Data on carbon coating failures and on pellet hardness are included. Results of Xe^{133} release measurements for pyrolytic C at 700 to 1300°C were analyzed. Carbon coated UO_2 powders were tested and are thought to be suitable for use in evaluation of techniques for estimating diffusion coefficients. Corrosion of INOR-8 by chemicals used in the fluoride volatility process was tested for 200 hr. Work on joining Zircaloy-2 and type-410 stainless steel by friction, explosive, and roll bonding is reported. Data on radiation stability of UO_2 are given in an evaluation of it for fuel material in gas-cooled reactors. (J.R.D.)

26471 (CISE-88) A NEW ROTATING ELECTRODES APPARATUS FOR PREPARING METALLOGRAPHIC SAMPLES. A. Bassi, E. Brutto, C. Corsetti, F. Mantega, and G. Perona (Centro Informazioni Studi Esperienze, Milan). June 1961. 31p.

The design, operation, and performance of a rotating electrodes apparatus for preparing metallographic samples are described. Samples may be etched directly after a simple grinding without preliminary polishing either with a diamond paste or electrolytically by accelerating the rotation of the anode. Etching is accomplished in 2 sec to 1.5 min. (N.W.R.)

26472 (KAPL-2000-13) REACTOR TECHNOLOGY REPORT NO. 16—METALLURGY. (Knolls Atomic Power Lab., Schenectady, N. Y.). July 1961. Contract W-31-109-Eng-52. 120p.

Welding and Brazing. A resistance autobrazing process was developed for joining metallic probes to semiconductive thermoelectric materials. A dynamic method for measuring temperatures in heat-affected zones of Zircaloy-2 weldments was devised using W-Re thermocouples which can record peak temperatures up to 1600 ± 30°C. Four brazing alloys for joining Inconel to Inconel were evaluated, and data are presented on their tensile properties, corrosion, and optimum brazing temperatures. Structural Materials. The results of an evaluation of a cast Inconel bottom transition piece are reported. Preliminary results are also reported for arc-melting of Na-reduced Zr sponge to produce a Zircaloy-2 ingot. Hydrogen pickup in Zr alloys by Sieverts apparatus or aqueous corrosion was found not to affect the appearance and distribution of hydrides in the alloys. Investigations were carried out on the aqueous corrosion resistance and high-temperature strength of modifications of the Zr–2 at.% Sn–2 at.% Nb alloy. Studies were made on the aging kinetics of Zr–Nb alloys in order to understand the mechanism of omega phase decomposition and the effects of O_2. Mechanical Properties of Structural Materials. The hardnesses of a large number of high-strength Zr alloys were measured at elevated temperatures. The fatigue strength of Zircaloy-2 weld metal was determined. Repeated shock tests were carried out on 17-4 pH steel to determine their effects on the steel plastic deformation. The tensile properties of vacuum-melted Inconel were found to be nearly the same as those for the air-melted material. The effect of neutron irradiation on the null ductility transition temperature of structural steels was found to follow a linear law on a semilog plot. Fuel and Control Materials. The results of fabrication of Sm, Eu, Gd, Dy, and Er strips are given. Procedures are described for preparing very dilute alloys of U in Zr for use as standards for alpha counting. The results of an attempt to produce Hf flat bar from arc-melted Hf sponge are reported. Theoretical relationships for thermal conductivity in aggregates are discussed. (D.L.C.)

26473 (NMI-4949(Pt.II)) TECHNICAL PAPERS OF THE TWELFTH METALLOGRAPHIC GROUP MEETING HELD AT MALLINCKRODT CHEMICAL WORKS URANIUM DIVISION, ST. LOUIS, MISSOURI, FEBRUARY 26, 27, 1958. H. P. Roth, comp. (Nuclear Metals, Inc., Concord, Mass.). May 12, 1961. 79p.

Included are six papers and an abstract of a paper presented at the Twelfth Metallographic Meeting. Information is presented on metallographic studies of irradiated UO_2-containing fuel elements, the structure of beta-quenched uranium, disturbed uranium surfaces, yttrium metal, specimen preparation by vibratory polishing, and structural analysis of uranium by preferential oxidation, and a discussion of recent advances in electron microscopy of metals. Separate abstracts were prepared for four of the papers. The three remaining papers were abstracted previously in NSA. (B.O.G.)

26474 (NMI-4949(Pt.II)(p.6-11)) A METALLOGRAPHIC STUDY OF THE STRUCTURE IN BETA-QUENCHED URANIUM. D. M. Cheney, A. A. Bauer, and R. F. Dickerson (Battelle Memorial Inst., Columbus, Ohio).

Observations were made with polarized-light photographs

at 0.1 to 0.23 mil intervals in depth in a uranium slug heat treated for 20 min at 730°C and water quenched, to compare the size of grains formed during quenching as a function of depth within the slug. It is felt that sufficient data were obtained to support the theory that the beta-quenched structure has a uniform rather than a duplex grain size. Included are 100X photographs showing the beta-quenched specimen. (B.O.G.)

26475 (NMI-4949(Pt.II)(p.12-14)) METALLOGRAPHY OF DISTURBED URANIUM SURFACES. H. P. Roth and R. B. Russell (Nuclear Metals, Inc., Concord, Mass.).

A discussion is given to show how the microexamination and x-ray-diffraction studies may work together in metallographic studies of disturbed uranium surfaces. Examples are included for comparison showing the effects of 4/0 emery paper, a cloth wheel, and 20- and 180-sec electropolishing. (B.O.G.)

26476 (NMI-4949(Pt.II)(p.15-29)) SOME METALLOGRAPHIC OBSERVATIONS ON YTTRIUM METAL. O. N. Carlson, D. T. Eash, and F. H. Spedding (Iowa State Coll., Ames).

A large number of etchants were tried on yttrium metal. Solutions containing HNO_3 as the active agent were the most satisfactory. The principal impurity phase in the yttrium used was identified as Y_2O_3. (auth)

26477 (NMI-4949(Pt.II)(p.50-68)) RECENT ADVANCES IN THE ELECTRON MICROSCOPY OF METALS. W. H. Bridges and E. L. Long, Jr. (Oak Ridge National Lab., Tenn.).

A review is presented of electron microscopy activities as applied at ORNL. The modification of replication procedures by an evaporated wetting agent parting layer was of great help in routine examination. (auth)

26478 (NP-10472) BIBLIOGRAPHY ON BERYLLIUM AND BERYLLIA: UNCLASSIFIED U.K.A.E.A. WORK. U. R. M. Chadwick, comp. (United Kingdom Atomic Energy Authority. Reactor Group, Risley, Lancs, England). June 30, 1961. 17p. (TRG-Inf. Ser.-63)

Included are 160 references to books, reports, patent specifications, and journal articles taken mainly from the U.K.A.E.A. index of reports and list of publications available to the public from January 1955 to March 1961. (P.C.H.)

26479 (TID-13375) PRELIMINARY LABORATORY INVESTIGATION OF NEW USES FOR DEPLETED URANIUM OXIDE IN THE CERAMIC INDUSTRY. C. C. Fain and G. C. Robinson (Clemson Coll., S. C.). Apr. 1961. For Oak Ridge National Lab. Subcontract 1484. 13p.

The possible use of depleted urania as minor additions to improve the properties of products having large markets was investigated. Urania–zirconia additions were found to improve the strength of magnesia refractories at high temperatures and to increase the thermal conductivity of silica refractories. Experiments with whiteware and clay products indicated that urania additions were of no value. (D.L.C.)

26480 (UCRL-5705(Suppl.1)) CURRENT BERYLLIUM LITERATURE: A SELECTED BIBLIOGRAPHY, AUGUST 1959–DECEMBER 1960. Zanier D. Lane (California. Univ., Livermore. Lawrence Radiation Lab.). May 1, 1961. Contract W-7405-eng-48. 56p.

Approximately 568 references are given to books, articles, and unclassified reports published in abstracts and indexes between August, 1959 and December, 1960. (P.C.H.)

26481 (WADD-TR-60-439) METAL-CERAMIC ABLATIVE COATINGS. R. C. Eschenbach and R. J. Wickham (Linde Co. Speedway Research Lab., Indianapolis). June 1960. Contract AF33(616)-6472. 30p. (AD-254038L).

The feasibility of arc and detonation applied metal–ceramic coatings for ablative protection in 100 to 1000 Btu/ft^2sec environments was studied. One-quarter inch thick coatings of a number of compositions were prepared and tested. Good thermal protection was achieved at both the high and low heat fluxes, but ablation occurred only at the high heat flux with good coatings. The best thermal protection was afforded by coatings made from powders having an original volume per cent of 70 Al_2O_3 + 30 Ni, 60 ZrO_2 + 40 B, 65 $ZrSiO_4$ + 35 B, and 60 Cr_2O_3 + 40 Al_2O_3. Other compositions tried were inferior in either heat blocking or thermal shock resistance. (auth)

26482 (AEC-tr-4451(p.239-46)) STUDY OF METALLIC COMPOUNDS IN A NICKEL-BASE MULTICOMPONENT ALLOY. R. B. Golubtsova and L. A. Mashikovich. Translated from Zhur. Neorg. Khim., 3: 717-21(1958).

An investigation was conducted on the possibility of separating the excess phases formed in a nine-component Ni base alloy. Electrolytes were devised to separate electrochemically the γ Ni solid solution, metallide phase, and carbide phase. Flotation separated the nonmetallic inclusions from the carbide phase. (D.L.C.)

26483 (NP-tr-641(Pts.I and II)) THE PRODUCTION AND TREATMENT OF STEEL AND ALLOYS, SYMPOSIUM 38. Translated from p.5-195; 209-44; 405-19; 433-583 of "Proizvodstvo i Obrabotka Stali i Splavov Sbornik XXXVIII," (a publication of the State Scientific–Technical Publishing House of Literature on Ferrous and Non-Ferrous Metallurgy, Moscow, 1958). Part I, 227p. and Part II, 229p. (MCL-595/III(Pts.I and II)).

Included are papers presented at the Symposium concerning studies of: the effects of the physical structure of agglomerates on their metallurgical properties; the mineralogical composition of fluxed agglomerates of Krivoy Rog iron ores; processes of steel refining in a flow of gaseous oxidizer; initial temperatures of the reduction of metal oxides by solid carbon; intensification of decarburization in open-hearth melting of high-phosphorus pig iron; heat absorption of an open-hearth bath in thermal work control processes; viscosity and electric properties of liquid binary alloys; heat exchange in an electric-arc furnace during steady heat flow; flow of metal and temperature leveling in a bath with electromagnetic stirring; degassing steel in ladles and molds; theory of metalloid solutions in metals; carbon transitions into solid solutions during induction heating of chrome steel; decomposition kinetics and heat-resistance of KhN80T alloys; elastic and internal friction properties of iron-vanadium alloys; effects of tempering on the modulus of rigidity and internal friction of hardened carbon steel; variations of internal friction and natural oscillation frequency of Kh18N9 steel during intercrystalline corrosion; effects of alloying additions on the structure and properties of high-nickel, heat-resistant alloys; effects of cold working on the structure and properties of Ni-Cr heat-resistant alloy E1437; recrystallization mechanisms at critical strain; stress analysis of polycrystalline AgCl by polarization optical methods; and the effects of tensile static and alternating stresses on the corrosion of 1Kh18N9 steel. (B.O.G.)

26484 (NP-tr-715) REFINING METALLIC LITHIUM. T. F. Fedorov and F. I. Shampay. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 6, 56-60(1960). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 11064.

26485 (NP-tr-723) VACUUM REFINING OF NIOBIUM. R. A. Ul'yanov, E. (Ye.) P. Nechiporenko, and N. D. Tarasov. Translated from Fiz. Metal. i Metalloved., 2: 461-4(1961). 7p.

The results of experiments on the vacuum refining of niobium and the production of a compact metal, as well as certain data on its structure and mechanical properties, are given. By vacuum refining at 2300 to 2350°, the adsorbed and dissolved gases and also the impurities lead, silicon, and iron are removed. Arc fusion of the refined niobium in neutral media purified by passage through fused lithium protects the metal from contamination by impurities. (P.C.H.)

26486 THE RADIOTRACER TESTING METHOD IN METAL CLEANING STUDIES. G. D. Fatzer, J. M. Schroeer, and B. E. Blake (IBM General Products Div., Endicott, N. Y.). Intern. J. Appl. Radiation and Isotopes, 10: 167-76(July 1961). (In English)

Radiotracer studies for testing the effectiveness of several cleaning techniques are described. The combination of metallic surfaces with sulfates, chromates, and fatty acids was investigated. The detection sensitivities for $S^{35}O_4^{2-}$, Cr^{51}, palmitic, and stearic-1-C^{14} acids were respectively 3×10^{-8} g, 1.5×10^{-7} g, 3.2×10^{-9} g, and 6.2×10^{-10} g. Results show that electro-polished copper surfaces retained less than 3×10^{-8} g SO_4^{2-} and less than 1.5×10^{-7} g of Cr. Toluene and chromic acid were found to be excellent cleaning agents for fatty acids. The quantity of fatty acid remaining on copper substrates after three successive immersions in toluene averaged 0.01 to 1 monolayer depending on the amount of the contaminant originally present. Less than 3×10^{-9} g of palmitic acid, 1.6×10^{-2} monolayer, or 6×10^{-10} g of stearic acid, 3×10^{-3} monolayer, remained on gold and copper surfaces after anodic polishing in chromic acid at 120°C for 2 min. (auth)

26487 THE INFLUENCE OF IODIDE IONS AND CARBON MONOXIDE ON THE ANODIC DISOLUTION OF ACTIVE IRON. K. E. Heusler and G. H. Cartledge (Oak Ridge National Lab., Tenn.). J. Electrochem. Soc., 108: 732-40(Aug. 1961).

The kinetics of the dissolution of iron in sulfuric acid was investigated by polarization measurements in the presence of iodide ions or carbon monoxide as an inhibitor. The measurements included an oscillographic study of transient phenomena as well as steady states. The adsorption of iodide ions or iron was measured as a function of iodide concentration and anodic current density. The effects of iodide ions and carbon monoxide depend on the amount of inhibitor adsorbed on the iron surface. A possible mechanism for the dissolution of iron in the presence of iodide ions and carbon monoxide was developed in analogy to the mechanism proposed earlier for the behavior in solutions not containing these inhibitors. (auth)

26488 DISPERSION-STRENGTHENED ALUMINUM ALLOYS. E. A. Bloch (Aluminium-Industrie-Aktien-Gesellschaft, Neuhausen-am-Rheinfall, Switzerland). Met. Revs., 6: 193-239(1961).

The manufacture, processing, joining, finishing, and application of dispersion-strengthened aluminum alloys from aluminum powder are discussed. The mechanical and physical properties, structure, and the relationship between mechanical properties and structure are given for the alloys. (N.W.R.)

26489 APPLICATIONS AND USES OF TITANIUM AND ITS ALLOYS. Robert L. Preece and K. W. J. Bowen (Imperial Chemical Industries, Ltd., Birmingham, England). Met. Revs., 6: 241-78(1961).

The applications and uses of titanium and its alloys are discussed. Included in this discussion is a brief summary of the history, advantages, scale of production, range of alloys, fabrication problems, and economics of the metals. Titanium and its alloys are discussed in terms of their uses in the following: aircraft, chemical, oil, automotive, and marine industries; military uses; nuclear energy; anodic polarization; platinized anodes; metal finishing processes; pulp and textile bleaching process equipment; surgery; instrumentation and electronics; and miscellaneous uses. (N.W.R.)

26490 ELECTROLYTIC REFINING OF BERYLLIUM. G. F. Silina and L. L. Grinberg. Tsvetnye Metally, 33: No. 12, 47-53(1960). (In Russian)

An electrolytic process of refining beryllium that would produce material sufficiently pure for nuclear engineering applications was investigated. Nickel strip cathodes and commercial grade beryllium anodes were used. To avoid contamination by chlorine, an electrolyte of KF–NaF–2 BeF_2 was first tried. The current efficiency attained was low; the metal was deposited in a finely-crystalline form and difficulties were experienced in washing off the solidified electrolyte. Since KCl–NaCl–2 BeF_2 proved unsatisfactory for the same reasons, an electrolyte consisting of approximately equal proportions of beryllium and sodium chlorides was employed in subsequent experiments. The results of tests in which the cathode current density was varied between 4 and 16 amp/dm^2 showed that up to 12 amp/dm^2 the current efficiency remains practically constant, and a compact beryllium deposit consisting of bright crystals is produced. When the current density was increased to 16 amp/dm^2, a small quantity of spongy deposit was formed. The beryllium anodes contained 4 to 5×10^{-2}% Fe, 1 to 5×10^{-2}% Al, 2×10^{-2}% Cu, 1×10^{-2}% Mn, and 5×10^{-2}% Ni. Variation of the anode current density between 6 and 50 amp/dm^2 hardly affected the impurity content of the cathode deposit, which contained 1 to 3×10^{-3}% Fe, 3×10^{-3}% Al and Ni, 1.5×10^{-3}% Cu, and 10^{-3}% Mn. Determination of the current efficiency was the object of the next series of experiments carried out at 3 to 4 amp, cathode current density 8.8 to 12 amp/dm^2, temperature 340°C, and voltage 0.3 to 0.5 v. It was found that the time required for the current efficiency to attain a steady value was the same (about 24 hr), irrespective of the purity of $BeCl_2$ in the electrolyte, but the maximum current efficiency attained was lower when impure $BeCl_2$ was used. The current efficiency and recovery attained in a 180 hour test were 85 and 83% respectively. Under these conditions, 50% of beryllium was deposited in the form of large, plate-like crystals and 50% in the form of smaller grains, strongly adhering to the cathode. In view of promising results obtained, a series of tests on an industrial scale was carried out. A standard bath for electrolytic extraction of beryllium was used. The anode consisted of seven beryllium powder compact rings (each weighing 1 kg), suspended on a graphite rod. The voltage and current employed were 5.5 v and 800 amp. The electrolyte (50:50 $BeCl_2$:NaCl) was replenished from an adjacent bath with an insoluble anode. The energy consumed in one test amounted to 34,000 amp-hr, the maximum output being 3.5 kg of refined beryllium, which corresponded to an average current efficiency of 80%. Recovery of beryllium attained was also 80%. The cathode deposit constituted 94% of the dissolved anode material. A homogeneous deposit, in the form of bright plate-like crystals, measuring 15 × 20 mm, was produced. For the preparation of anodes, beryllium obtained either electrolytically or by thermal reduction of fluoride, was used. In the former case, it contained 0.02–0.05% Fe, 0.1% Ni, and 0.005–0.008% Cu; in the latter

case the impurity content was 0.12% Fe, approximately 0.01% Ni, and 0.01% Cu and Mn. In most cases the refined metal contained 0.005–0.006% Fe, 0.01% Ni, and 0.003% Cu; the manganese content did not exceed $n \times 10^{-4}$%, that of zinc and silicon being less than $n \times 10^{-3}$%; the deposit contained less than 0.3 g/t boron and less than 0.04 g/t rare earths. The metal in the anodic slime collector contained (after washing) 0.05–0.02% Fe, 0.05–0.03% Ni, and 0.02–0.03% Cu; no agglomeration of impurities in the electrolyte was observed. It was concluded that beryllium obtained by the process described satisfies most stringent requirements and approaches in quality metal refined by distillation. (OTS)

26491 THE RARE EARTHS. F. H. Spedding and A. H. Daane, eds. New York, John Wiley & Sons, Inc., 1961. 652p.

The edited papers of a symposium held in November, 1959, make up the contents. The associated elements La, Y, and Sc are also included. Subjects included are: chemistry of the rare earths; separation by fractional crystallization, liquid–liquid extraction, and ion exchange; preparation of the rare earth fluorides; rare earth and yttrium halides for metal production; metallothermic preparation of rare earth and yttrium metals; electrolytic metals; refining and purification; mechanical fabrication; physical properties, crystallography, metallography, and phase diagrams of the rare earth metals; principles of the alloying behavior of the metals; mechanical properties of yttrium, scandium, and the rare earth metals; applications of the metals in magnesium technology and to ferrous and nonferrous alloys; nonnuclear, nonmetallic uses; nuclear applications of yttrium and the lanthanons; and analytical chemistry and spectroscopy of the rare earths. (P.C.H.)

26492 GRAPHITE COMPOSITIONS AND PROCESSES. (to U. S. Atomic Energy Commission). British Patent 874,592. Aug. 10, 1961.

A process for making graphite is outlined using a binder which does not become liquid during the baking step. The binder is furfuryl alcohol with a polymerization catalyst. Since $UO_2(NO_3)_2 \cdot 6H_2O$ can be used as the catalyst, it is possible to produce uranium-loaded graphite bodies. In extruding such graphite bodies, a strengthener-lubricant such as methyl cellulose may be used. Examples of the process are given. (D.L.C.)

26493 PRODUCTION OF IMPROVED BERYLLIUM. Thomas Raine and James Alan Robinson (to Associated Electrical Industries Ltd.). British Patent 875,539. Aug. 23, 1961.

Beryllium of improved corrosion resistance to CO_2 at high temperatures can be produced by melting under the action of an electric arc in vacuum or an inert gas of low pressure. (D.L.C.)

26494 IMPREGNATION OF CARBONACEOUS MATERIALS WITH EPOXY RESINS. Ronald William Reidl and Michael Anthony Bobal (to Union Carbide Corp.). British Patent 875,835. Aug. 23, 1961.

Baked, impervious carbon articles may be produced by impregnating carbonaceous materials with a thermosetting epoxy resin and curing with dicyanamide solution. Data are presented on the pot life of various epoxy impregnant compositions and on the properties of impregnated graphite bars. (D.L.C.)

26495 METHOD OF PREPARING PETROLEUM COKE THAT CAN BE TRANSFORMED INTO MODERATOR GRAPHITE FOR NUCLEAR REACTORS. (to N. V. de Bataafsche Petroleum Maatschappij). French Patent 1,223,808. Feb. 1, 1960.

A petroleum distillate, preferably a recycle oil from a catalytic cracking process or the distillation residue from the thermal reforming of naphtha, is blown at 250 to 350°C with 50 to 175 g O_2 per kg hydrocarbons and cokefied. (NPO)

26496 NEW APPLICATION OF VITREOUS SILICA. (to Commissariat à l'Énergie Atomique). French Patent 1,233,087. May 2, 1960.

The application of polished vitreous silica tubes as liners for fuel element channels is described. Sections of these tubes are joined with rings of sintered Al; dimensional changes are compensated by spring systems. Various constructions are given. (NPO)

26497 METHOD OF PREPARING MODERATOR GRAPHITE FOR NUCLEAR REACTORS. (to Shell Internationale Research Maatschappij N. V.). French Patent 1,234,039. May 9, 1960.

A binder and impregnant for the manufacture of carbon compacts is obtained by blowing a reformer residue with air or oxygen at 150 to 400°C, preferably at 200 to 250°C and distilling the product thus formed until the residue has a softening point of at least 80°C and a specific gravity of at least 1.1 (25/25°C). (NPO)

26498 METHOD FOR MANUFACTURING NEUTRON MODERATING MATERIALS. (to LeCarbone-Lorraine). French Patent 1,236,101. June 7, 1960.

Porous graphite compacts are impregnated with a concentrated alkali borate solution, dried, and baked at 220 to 250°C with the exclusion of air. To prevent the exudation of the impregnant during drying and baking, the compacts are temporarily coated with a thin layer of plaster powder. For nuclear energy purposes a content of 2% by weight of B in the moderating material is preferred. (NPO)

Corrosion

26499 (NP-10575) BIBLIOGRAPHY ON OXIDATION AND EROSION RESISTANT COATINGS FOR MOLYBDENUM, TUNGSTEN AND TANTALUM. John Huminik, Jr. and Charles H. Wright (Value Engineering Co., Inc., Alexandria, Va.). Aug. 30, 1960. Contract DA-36-034-ORD-3270 RD. 57p.

References (175) are given to patents, general literature, and government reports published mainly since 1955. Abstracts are given for each reference. (P.C.H.)

26500 (CEA-tr-R-917) INSTALLATION POUR L'ETUDE DU COMPORTEMENT AUX TEMPERATURES ELEVEES DES METAUX SOUMIS A LA CORROSION DANS DES MILIEUX FORTEMENT AGRESSIFS. (Installation for Study of Behavior of Metals When Subjected to High Temperatures and Strongly Reactive Media). V. I. Ginzburg. Translated into French by B. De Trezvinsky from Zavodskaya Lab., 25: No. 2, 220-2(1959). 8p.

A laboratory installation of molybdenum glass simulating the technological regime of industrial installations was constructed to study the high temperature behavior of metals in corrosive media. A detailed sketch of the apparatus is given and discussed. (J.S.R.)

26501 (CEA-tr-X-387) RECHERCHES EXPERIMENTALES SUR L'OXYDATION DU ZIRCONIUM ET DE SES ALLIAGES. II. MECANISME D'OXYDATION DES ALLIAGES AU ZIRCONIUM–TELLURE. (Experimental Investigations of the Oxidation of Zirconium and its Alloys. II. Mechanism of Oxidation of Zirconium–Tellurium Alloys). T. Sano, S. Imoto, and M. Kang. Translated into French from Nippon Kinzoku Gakkaishi, 24: 604-7(1960). 25p.

It has been shown that the addition of tellurium improves the oxidation resistance of zirconium at high temperatures. In order to determine the origin of the improved resistance, tests were made which led to the following conclusions. Although it could not be established that the efficient concentration of tellurium increases with increase of the oxidation temperature, the addition of tellurium results in the lowering of the mobility of oxygen ionic voids according to the difference in the ionization potential of tellurium and zirconium. This addition does not greatly affect the concentration of the oxygen ionic voids of zirconium. A confirmation of this phenomenon is obtained from the slight variations of the efficacious tellurium concentrations in Zr–N alloys. From the experimental results the Te added is found in the ZrO_2 more often in the form of Te^{4+} than Te^{6+}. This deduction appears correct from the ionic radius and the ionization potential. The small amount of Te added, 100 to 200 ppm, is emphasized. This proportion of Te atoms is much lower than the number of oxygen ionic voids in the alloy. (tr-auth)

26502 APPLICATION OF RADIOACTIVE ISOTOPES TO THE STUDY OF CORROSION PROBLEMS. Kurt Schwabe. Chem. Tech. (Leipzig), 13: 275-80(May 1961). (In German)

By investigation of the anion adsorption on metal surfaces (Fe, Ni, and Pt) with labeled ions, the corrosion-accelerating effect of Cl^- with its preferable solid adsorption was explained. The primary corrosion layer can be explained, on the basis of the kinetics measured, as exchange adsorption in which the oxygen chemisorbed on the metal surface was displaced by the anions. Investigations with labeled indicators show that inhibitors protect the bare metal in the form of a monolayer, whereas vapor-phase inhibitors fill pores in the oxide covered layer and therefore less than 10% of a monolayer offers good protective effects. The oxidation velocity of evaporated Ni, Fe, and Pt films leads rapidly in Fe to the oxide phases; in Ni, only chemisorption occurs at room temperatures. Pt chemisorbs O_2 slowly at room temperature. The exchange measured with O_2 with the gas phase occurs on Pt over 275°C, on Ni over 450°C, and on Fe over 400°C. (tr-auth)

26503 THE HIGH TEMPERATURE OXIDATION OF BERYLLIUM. PART V. IN MOIST CARBON DIOXIDE AND MOIST CARBON MONOXIDE. S. J. Gregg, R. J. Hussey, and W. B. Jepson (Univ. of Exeter, Eng.). J. Nuclear Materials, 4: 46-58(May-June 1961). (In English)

The chemistry and the kinetics of the oxidation of electrolytic flake beryllium in moist carbon dioxide and in moist carbon monoxide (either gas, total pressure 10 cm of mercury; partial pressure of water, 1.2 cm) were investigated at temperatures in the ranges 500 to 750°C and 600 to 700°C, respectively. In moist carbon dioxide, the reaction with water vapor predominates over that with carbon dioxide in the proportions of approximately 4 : 1, the reactions are: $Be + H_2O = BeO + H_2$; $Be + CO_2 = BeO + CO$; and $2Be + CO_2 = 2BeO + Be_2C$. The oxidation is protective up to 600°C and non-protective at 650°C and above; the reaction after breakaway takes place at the particle boundaries giving rise to an interpenetrating region of oxide and unattacked metal. In moist carbon monoxide, the principal reaction is with water vapor and the reaction $Be + CO = BeO + C$ only contributes about 3% to the total weight gain. An investigation of the oxidation in a moist carbon monoxide–carbon dioxide mixture (partial pressures: water, 1.2 cm; carbon monoxide, 0.5 cm; carbon dioxide, 8.3 cm) at 700°C shows that the kinetics are the same as in moist carbon dioxide, the reaction with carbon monoxide only contributing 0.2% to the total weight gain. (auth)

26504 ALUMINUM CORROSION IN WATER-COOLED REACTORS. K. H. Buob and E. Schenker (Institut für Reaktorforschung, Würelingen, Switzerland). Neue Tech., 3: 288-95(May 1961). (In German)

Practical experience with 2S aluminum and pure aluminum (99.5%) was gained in the swimming-pool reactor Saphir. The fuel elements are severely corroded in the brazing zones and show some pitting, but after 5 years of service they are still in good shape. A typical example of crevice corrosion occurred at the irradiation facility where aluminum is coupled with stainless steel. A leak developed in the joint and the aluminum tube was severely corroded. Measures for improvement of the corrosion stability are discussed. (auth)

26505 THE CORROSION RESISTANCE OF ZIRCONIUM ALLOYS IN WATER AT HIGH TEMPERATURES. M. A. Tolstaya, G. N. Gradusov, and S. V. Bogatyreva (Moscow Power Inst.). Teploenergetika, No. 10, 95(1960). (In Russian)

Tubular specimens were tested at temperatures of 263°C (50 atm) and 310°C (100 atm) in pure water and in water containing chlorine ions (10 mg/l) for 2300 hours. It was established that the corrosion rate was greatly influenced by the quality of the surface treatment of the specimen and by contact with teflon linings. The other factors investigated did not affect the rate of corrosion. (OTS)

Fabrication

26506 (ANL-6340) PREPARATION OF HIGH-DENSITY, SPHERICAL THORIUM OXIDE PARTICLES WITH UP TO 10 ATOM PERCENT URANIUM. C. E. Crouthamel, W. G. Knapp, S. B. Skladzien, and J. W. Loeding (Argonne National Lab., Ill.). June 1961. Contract W-31-109-eng-38. 14p.

A discussion is given of a fabrication process for preparing spherical particles of thorium oxides containing 10 wt.% uranium homogenously distributed throughout the thoria matrix from a sol prepared from $Th(NO_3)_4$ reaction with NH_4OH, in which uranyl nitrate is dissolved. The particles formed are 5 to 50 microns in diameter. The process is felt to be adaptable to large-scale production. (B.O.G.)

26507 (ARF-2187-4) DUCTILE BERYLLIUM ALLOYS. Bimonthly Report No. 4. Frank A. Crossley and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 18, 1960. Contract NOas-60-6036-c. (AD-239695)

An envelope-type microstructure prepared by liquid-phase sintering is being investigated as a means of producing ductile beryllium alloys. Partial results of evaluations of five compacts with ternary additions are reported. Ternary additions of cerium or yttrium were made to aluminum matrix compacts and of calcium, cerium, or yttrium to silver matrix compacts. The ternary additions are being tested for their effect on sinterability. Three compacts of the Be–31Al–2Ge alloy made with beryllium powders representing two sources and two particle size ranges were partially evaluated by cold pressing, annealing at 500°C for 2 hr, and then cold rolling. Total cold reductions to fracture were in the range from 36 to 43%. Alloys of the Be–Al–Ge system containing 6.4, 3.5, and 2.1 vol.% matrix, respectively, were not successfully sintered at 950°C for 1 hr. A Be–65Ag–1Ge compact was partially evaluated

by cold pressing, annealing at 500°C for 2 hr, and cold rolling. Total cold reduction was 47%. (auth)

26508 (ASC-TR-7-785(II)) MOLYBDENUM ALLOY EXTRUSION DEVELOPMENT PROGRAM. Second Interim Technical Engineering and Phase II Report, November 15, 1960–May 15, 1961. P. A. Santoli (Allegheny Ludlum Steel Corp. Research Center, Brackenridge, Penna.). July 1961. Contract AF 33(600)-40861. 166p.

A process of producing and evaluating wrought and cast TZM (Mo–0.50% Ti–0.09% Zr–0.02% C) for extrusion billets was developed. The most suitable method involves wrought TZM in the recrystallized condition after primary working by extrusion of arc-cast ingots. A more uniform, fine grain structure is considered possible by subsequent rolling of the extruded and recrystallized material to the required billet size. Methods of chemical analysis, ultrasonic inspection, and metallographic examination were developed and considered reliable within certain process limits. The extrudability of wrought TZM in terms of response and surface finish was better than that of cast TZM as determined by extrusion at reduction ratios of about 11:1, 14:1, and 17:1 from the temperature range of 2600 to 3740°F. Room temperature and elevated tensile properties of as-forged and heat treated TZM were comparable to those reported in the literature for TZM of similar analysis and condition. (auth)

26509 (ASC-TR-7-882(III)) HIGH ENERGY RATE EXTRUSION. Interim Technical Progress Report No. 3, Phase II, April 1 to June 30, 1961. G. A. Reimann (Westinghouse Electric Corp. Materials Manufacturing Dept., Blairsville, Penna.). Contract AF33(600)-41948. 24p.

Problems with punches and dies, and the need for effective lubrication are discussed. The 90 and 120° orifices were found more efficient for extruding plain carbon steel, 4340 steel, 304 stainless, and the titanium alloy. A method for determining Dynapak energy and impact velocity is presented. (auth)

26510 (BMI-1527) INCORPORATION OF A BORON BURNABLE POISON AND SPHERICAL UO_2 IN SM-2 STAINLESS-MATRIX FUEL PLATES. Stan J. Paprocki, Donald L. Keller, George W. Cunningham, and Andrew K. Foulds (Battelle Memorial Inst., Columbus, Ohio). July 6, 1961. Contract W-7405-eng-92. 52p.

A fuel plate containing 26 wt % UO_2 dispersed with ZrB_2 in a low-cobalt low-tantalum type 347 stainless steel matrix is developed as a reference design for the SM-2 reactor. Design conditions include a maximum center-line temperature of 684°F, an average heat flux of 1.65×10^5 Btu/(hr)(ft^2), and an average burnup of 39 per cent of the U^{235}. The improvement achieved over previously used UO_2 stainless steel dispersions may be attributed principally to the use of spherical UO_2 and the use of ZrB_2 as a burnable poison. The spherical UO_2 produces stronger cores with a more uniform dispersion and less stringering and fracturing of the UO_2 particles than does hydrothermal UO_2. The use of ZrB_2 combined with vacuum sintering at 2150°F and controlled hot rolling at 2200°F to about an 8-to-1 reduction in evacuated picture-frame packs allows the control of boron content to ±5 per cent. (auth)

26511 (CVNA-85) BRAZING ZIRCALOY FUEL ASSEMBLY COMPONENTS FOR THE CAROLINAS VIRGINIA TUBE REACTOR, CVTR PROJECT. Terminal Report. P. P. King (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). [1960]. Contract AT(30-1)-2289. 40p.

Zirconium–beryllium, zirconium–beryllium–iron, and zirconium–beryllium–copper brazing alloys were investigated with respect to corrosion resistance and mechanical strength after joining to Zircaloy components by brazing. The zirconium–beryllium alloys had the best corrosion resistance in 680°F neutral, degassed, demineralized water at 2705 psi, and the highest average joint strengths. Alloy powders made by hydriding, crushing in argon, and vacuum degassing had a minimum of hydrogen, oxygen, and nitrogen contamination in the brazing alloy. Brazing temperatures and times at temperature were found to be critical in minimizing brazing alloy penetration into the base metal. Short times at brazing temperatures followed by an 800°C diffusion treatment proved to be the most satisfactory method for producing strong, corrosion resistant, reproducible joints without eroding the base metal. Several brazed Zircaloy end rings were used satisfactorily in the CVTR inpile loop and in the CVTR Phase II loop study. (auth)

26512 (DMIC-Memo-121) FABRICATING AND MACHINING PRACTICES FOR THE ALL-BETA TITANIUM ALLOY (Ti–13V–11Cr–3Al). C. T. Olofson and F. W. Boulger (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Aug. 3, 1961. 9p.

Processing practices for the Ti–13V–11Cr–3Al all-beta alloy are reviewed. Heat treatment, descaling, forming, spinning, dimpling, stretch forming, bending, drilling, tapping, and turning are discussed. (M.C.G.)

26513 (GA-2314) A PROGRAM OF RESEARCH ON MECHANICAL METALLURGY AS RELATED TO FUEL-ELEMENT FABRICATION. Quarterly Progress Report for the Period Ending March 31, 1961. T. A. Trozera, J. L. White, and R. H. Chambers (General Atomic Div., General Dynamics Corp., San Diego, Calif.). July 18, 1961. Contract AT(04-3)-167. 28p.

Deformation and Fabrication Characteristics of Reactor Materials. Yield-stress curves for Type 1100 aluminum after drawing through a die semiangle of 3° are compared with a master curve corrected for necking. Results are presented for tension tests on tubes and rods produced in this manner. Stored Energy of Cold Work. Studies of energy storage in OFHC copper deformed by compression show that the stored energy is greater in fine-grain specimens than in coarse-grain specimens. Work done on copper–nickel alloys indicates that alloying elements increase greatly the stored energy. Acoustical Relaxation Spectra of Cold-Worked Metals. Experiments were made on very pure tantalum to measure its microflow properties, and the results are presented in terms of internal friction vs tensile force and oscillating strain amplitude graphs. (D.L.C.)

26514 (GEAP-3486) FAST OXIDE BREEDER PROJECT I–FUEL FABRICATION. PART I. PLUTONIUM-URANIUM DIOXIDE PREPARATION AND PELLETIZED FUEL FABRICATION. Jesse M. Cleveland and William C. Cavannaugh. PART II. FABRICATION OF PLUTONIUM-URANIUM DIOXIDE SPECIMENS BY SWAGING. M. E. Snyder and W. C. Cowden (Genergl Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Aug. 15, 1960. Contract AT(04-3)-189. 49p.

Forty mixed oxide (20% plutonium dioxide–40% uranium-235 dioxide–40% uranium-238 dioxide) fuel specimens were fabricated for irradiation testing in the General Electric Test Reactor. The material for these specimens was prepared by mixing nitrate solutions of the three isotopes in the proper ratio and precipitating with ammonium hydroxide. After drying, the precipitate was reduced to oxide in a hydrogen–nitrogen atmosphere at 900°C. Finely-ground powder was pressed into pellets at 43,200 psi pressure and

sintered, generally for four hours, in a helium–hydrogen atmosphere at 1600 to 1700°C. The resulting pellets had lengths of about 0.250 inches, diameters of 0.149 inches, and generally, densities approximately 95% of theoretical. These pellets were used in 22 of the 40 specimens. Eighteen specimens were fabricated by swaging. The powder for these specimens was high-fired at 1350 to 1400°C in hydrogen–helium to achieve a bulk density of 40 to 50% of theoretical. Swaged density was 75%. The time required to fabricate the pelleted specimens was approximately twice that required for the swaged specimens. (auth)

26515 (NOR-61-163) PROGRAM FOR THE DEVELOPMENT OF EXTRUDED BERYLLIUM SHAPES. Interim Engineering Report No. 12, March 1, 1961 through May 31, 1961. (Northrop Corp., Hawthorne, Calif.). Contract AF33(600)-36931. 17p.

Phase 1 of the beryllium extrusion program is summarized. Ten to 12 ft lengths of defect-free material were produced occasionally. Efforts were then directed toward the development of 20-ft extrusions and the extrusion from Push No. 135 resulted in a 26-ft extrusion with only a few defects. It was not possible to develop a reasonable degree of consistency. Because of this, arrangements were made to have an exploratory extruding effort performed with a faster press. An improvement was obtained in repeatability of results and reduction of cracking. A composite lubricant system (non-glass) was developed and adapted to the target channel shape. (auth)

26516 (NP-10408) PYROLYTIC CARBIDE DEVELOPMENT PROGRAM, MONTHLY PROGRESS REPORT, JUNE 1961. (High Temperature Materials, Inc., Boston). June 30, 1961. Contract NOw-60-0292-(FBM). 6p.

Two symmetric Polaris nozzles were coated with niobium carbide during the investigation of the carbide coating of full scale nozzles. An effort was made to eliminate nonuniformity of deposits and the non-reproducibility of deposition rates due to growth formations on injector tips. An injector evaluation study resulted in improved injector performance. One hafnium carbide coated nozzle was fired for evaluation. The coating failed in five seconds. (auth)

26517 (NP-10491) A STUDY OF EXPLOSIVE FORMING SELECTED REFRACTORY METALS. Progress Report No. 1, Report Period: Through June 30, 1961. (Chromalloy Corp. Propellex Chemical Div., Edwardsville, Ill.). July 15, 1961. Contract NOw 61-0832-C. 22p.

Activities in a program to develop techniques for explosively forming refractory metals is presented. The work completed during the report period is preparatory and includes activities such as program scoping, materials price inquiries, and review of past similar research. (J.R.D.)

26518 (NP-10602) THE DEVELOPMENT OF FABRICATING TECHNIQUES FOR PRODUCING HIGH PURITY RHENIUM STRIP 6'' × 6'' × 0.005''. Quarterly Report No. 4, April 1, 1961 through June 30, 1961. A. H. Springmeyer and J. H. Port (Chase Brass and Copper Co., Inc., Waterbury, Conn.). July 25, 1961. Contract NOas-60-6066-f. 7p.

The fabricating procedure for the conversion of several sintered compacts of rhenium powder to thin gage sheet is given. Two samples of electron-beam melted ingot are rolled to 0.085 in. gage, one at room temperature and the other at 300 to 500°F. The warm rolled sample fabricated slightly better than the other sample in that the amount of edge cracking is somewhat less. These samples will be rolled to 0.005 in. gage during the final period of this contract. (N.W.R.)

26519 (TID-11628) SLIP CASTING OF NUCLEAR FUEL ELEMENTS. Terminal Report. Gregory J. Comstock and Edward H. Baron (Stevens Inst. of Tech., Hoboken, N. J. Powder Metallurgy Lab.). Nov. 1, 1960. Contract AT(30-1)-2258. 42p.

Room temperature tensile properties are given for a series of slip cast APPR-type UO_2 stainless steel fuel plate sections. Properties of conventionally fabricated type SM-1 dispersion plates were determined for comparison. Slip cast fuel plates sintered to 90% density, hot or cold rolled approximately 30%, and annealed 1 hour at 1120°C showed ultimate tensile strengths equal to those of the conventional plates, slightly lower yield strengths, and tripled ductility. All of the slip cast plates, in the annealed condition, and all of the conventional plates withstood 90° cold bends around a sharp-edged punch (0° radius) without visible cracking. Superheated water corrosion tests of two weeks duration at 330°C resulted in only superficial attack and no blistering or separation of cladding. It was demonstrated that half length fuel plates could be cast and sintered successfully. An investigation of the basic variables involved in the slip casting process was started. Techniques for measuring slip stability and castability were evolved and preliminary tests were made. Tests were also started to determine the effect of particle size distribution on the green and sintered densities of slip castings. Development work was started on methods for applying the ''picture frame'' to slip cast fuel plates. Liquid phase sintering tests were made to determine the conditions by which high densities might be obtained at reduced sintering temperatures. By using boron-containing brazing powders to induce the liquid phase, the required amount of B^{10} burnout poison could also be introduced. (auth)

26520 (TID-13156) DEVELOPMENT OF ULTRASONIC ROLL-BOND CLADDING FOR PLATE-TYPE FUEL ELEMENTS. Monthly Progress Report No. 5, May 1–May 31, 1961. Harold L. McKaig, Jr. (Aeroprojects, Inc., West Chester, Penna.). July 10, 1961. Contract AT(30-1)-1836. 7p.

Effort was applied to concepts for edge cladding of fuel elements which may be amenable to automation and to elimination of dissolved hydrogen as a cause of blistering. Examination of several 90° bent face-clad specimens indicated high integrity of the clad-core interface. (J.R.D.)

26521 (TID-13339) AN INVESTIGATION OF DISPERSION HARDENING IN THE URANIUM–URANIUM DIOXIDE SYSTEM–RESEARCH IN PROGRESS. W. Arbiter (Nuclear Development Corp. of America, White Plains, N. Y.). May 18, 1960. Contract AT(30-1)-2303. 28p.

Joint USAEC-AECL Conference at Chalk River, Ontario, Canada.

Metallic U is a desirable fuel material for both fast and thermal reactors. However, at low temperatures its anisotropy can result in growth under irradiation with little or no decrease in density, while at temperatures where this effect diminishes (900 to 1000°F) other destructive mechanisms are encountered. The U increases in volume due to fission gas bubble formation and an inability of the metal to resist the stresses thus imposed. In a study to alleviate these limitations without detriment to neutron economy, a study of dispersion hardening in the $U–UO_2$ system was undertaken. The results of an initial study showed that substantial improvement in both thermal cycling stability and transverse bend strength at elevated temperature are achieved in dispersion-hardened unalloyed U. Further work is in progress in which oxide content and spacing will be controlled, and fabrication procedures studied, in order

that optimum structures for the thermal and radiation stability can be achieved ultimately. (auth)

26522 (AEC-tr-4764) NEW PROCESS AND APPARATUS FOR THE MANUFACTURE OF POROUS MEMBRANES. Translated for Oak Ridge Gaseous Diffusion Plant from French Patent No. 1,213,624, Sept. 18, 1958. 18p.

A fabrication process and rolling mill layout for the manufacture of porous membranes from polytetrafluoroethylene powder and without the formation of a paste to bronze, nickel, or silver sheet,is described. The process is characterized in that the polytetrafluoroethylene powder is plastified by pulverization and diffusion in a plastifier, brought to a suitable viscosity, by means of a rotating drum containing the polytetrafluoroethylene powder, and by the fact that the powder which is plastified in this manner is preformed into a film on an intermediate support, generally eliminating at least the major portion of plastifier, and then the film which is preformed in this manner is subsequently transferred onto the metal sheet support. (N.W.R.)

26523 FABRICATION OF HIGH-DENSITY UO_2 FUEL PLATELETS. B. E. Schaner (Westinghouse Electric Corp., Pittsburgh). Am. Ceramic Soc. Bull., 38: 494-8 (1959). (WAPD-T-751)

High density UO_2 fuel element platelets as thin as 0.040 in. were fabricated to precise dimensional tolerances using improved cold pressing and sintering techniques. Densities above 96% of theoretical were obtained by comminution of powder and sintering in H_2 at temperatures in excess of 1700°C. With the addition of small quantities of metal oxides to the UO_2 powder, densities as high as 99% of theoretical were obtained at 1500°C without increase in sintering time. Dimensions of these plates were controlled to ±0.003 in. in the laboratory and to ±0.002 in. in pilot plant production runs. (auth)

26524 PERCUSSIVE WELDING DOES THE FINEST WORK. W. A. Owczarski and A. J. Palmer (Knolls Atomic Power Lab., Schenectady, N. Y.). In "American Machinist/Metalworking Manufacturing, June 12, 1961." New York, McGraw-Hill Publishing Co., 1961.

The equipment and technique used for percussive welding of small diameter wires are described. The method consists of bringing two workpieces together rapidly, and, just before they meet, a flash of arc melts both the colliding surfaces. The molten surfaces are then squeezed together by the collision, and some of the metal is forced out to the sides of the joint. This method can join dissimilar metals and fine wires to larger pieces. (N.W.R.)

26525 EVAPORATED CARBON FILMS OF LARGE AREA FOR ADSORPTION STUDIES BY ELECTRON BOMBARDMENT. A. E. Bell, J. Pritchard, and K. W. Sykes (Univ. of London). Nature, 191: 487-8(July 29, 1961).

A technique is presented for the preparation of evaporated carbon films which allows almost 100% evaporation of the carbon used. Only a light electrical contact to the carbon is required so that mounting difficulties are reduced. Applications for adsorption studies by electron bombardment are discussed. (C.H.)

26526 WELDING RESEARCH ON ZIRCALOY-2 AND TITANIUM SINGLY AND IN COMBINATION. E. Bodmer and R. Ferrarini (Gebr. Sulzer A. G., Winterthur, Switzerland). Neue Tech., 3: 296-301(May 1961). (In German)

A method is described by which titanium and Zircaloy-2 are welded singly and in combination. The mechanical properties of the welding samples were determined from the static tensile test and may be described as good. On the other hand static corrosion tests in steam at 400°C and 100 kg/cm^{-2} showed that the combined welds (Ti on Zy-2) are practically useless. (auth)

26527 IMPROVEMENTS IN OR RELATING TO THE WELDING OF ZIRCONIUM. Alan Garlick (to United Kingdom Atomic Energy Authority). British Patent 874,271. Aug. 2, 1961.

A method for welding Zr to stainless steel or mold steel is given. The method comprises using V adjacent to the stainless steel and Nb or Ti adjacent to Zr during the welding process in order to prevent burnthrough and formation of an extremely hard material on the fused regions. (D.L.C.)

26528 IMPROVEMENTS IN OR RELATING TO ELECTRIC RESISTANCE HEATING AND FORMING OF METAL ARTICLES. Ernest John French and Malcolm Douglas Hannah (to United Kingdom Atomic Energy Authority). British Patent 874,423. Aug. 10, 1961.

A method is outlined for sealing a metal member A in passage through a plate of metal B which cannot be joined directly to metal B, by interpositioning a metal C which can be joined to both A and B. The method is effected by welding a stack comprising a base sheet of metal B, e.g., Mg, and sheets of metal C, e.g., Ti, with an electrode containing a cavity on its face in contact with the stack. A projection of metal C is formed by the cavity, and a metal member, e.g., a stainless steel tube, may be inserted through the projection. Variations of this method are described. (D.L.C.)

26529 AN IMPROVED METHOD OF FORMING APERTURES IN THE WALLS OF PRESSURE VESSELS AND IMPROVED TOOLS SUITABLE FOR CARRYING OUT THE METHOD. Sidney James Stockman, John Malcolm Jackson, and Donald Leslie Jarman (to Babcock and Wilcox Ltd.). British Patent 875,520. Aug. 23, 1961.

A fast method and equipment are described for cutting accurately positioned apertures in the walls of large pressure vessels. A pilot hole is formed through the wall within the required aperture, and a frame is mounted on the pressure vessel for supporting a rotatable flame cutting tool. The pilot hole is used to observe the position of the rotation axis of the cutting tool, and the cutting tool head is adjusted to achieve the desired axis position. (D.L.C.)

26530 METHOD OF METAL COATING. (to United Kingdom Atomic Energy Authority). French Patent 1,203,765. Aug. 3, 1959.

A method and apparatus are described for nickel plating metallic, e.g. U, objects. The article is first degassed in a container at 250 to 1000°C and less than 10^{-3} mm Hg; then the temperature is lowered to 180 to 250°C, preferably 225°C, and nickel carbonyl is introduced into the container at a pressure of 0.01 to 3 mm Hg. Finally the coated U article is heated at 500 to 600°C to effect interdiffusion of Ni and U. (NPO)

26531 IMPROVEMENT IN THE CLOSING OF THE EXTREMITIES OF FUEL ELEMENT CANS WITH WELDED CAPS. (to Commissariat à l'Énergie Atomique). French Patent 1,238,811. July 11, 1960.

The end caps are autogenously welded in the usual way on the cylindrical cans. By means of the Schoop process a quantity of creep-resistant metal is applied around the caps and the extremities of the can. The metal can be machined to shape it into a flat support. (NPO)

26532 METHOD FOR PROTECTING URANIUM AGAINST OXIDATION. (to United Kingdom Atomic Energy Authority). French Patent 1,239,112. July 11, 1960.

Uranium slugs are protected against oxidation by oxidizing gases by coating them with a thin nitride or phosphide layer prior to canning. These layers are formed by heating the slugs for several hours in purified N_2 at 550°C or in purified and dried PH_3 at 500 to 1000°C. (NPO)

Properties and Structure

26533 (AERE-M/R-2727) AN EXPLORATORY STUDY OF THE $BeO-UO_2-ThO_2$ SYSTEM. K. D. Reeve (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1958. 28p.

Various $BeO-UO_2-ThO_2$ compositions were examined, after high temperature treatment, by x-ray and metallographic methods. No interaction product other than a UO_2-ThO_2 solid solution, which forms readily, was observed. However, these compositions are sensitive to carbon contamination, and a phase which is either UO or UO–UC appears after prolonged heating in the carbon-tube furnace. Melting-point studies confirmed that the $BeO-UO_2-ThO_2$ system can be considered as quasi-binary, with a eutectic at 60-80 mole % BeO at about 2100°C. The behavior of BeO-rich compositions on heating above 2100°C was studied petrographically. The densities attained on fabrication of compacts by cold-pressing and sintering and by hot-pressing during the course of the work are presented. An assessment is made of the potentialities of neutron diffraction for the study of such systems. (auth)

26534 (ARF-2200-12) THE BORON–CARBON SYSTEM. Final Technical Report, May 1, 1960–April 30, 1961. Rodney P. Elliott (Illinois Inst. of Tech., Chicago. Armour Research Foundation). June 7, 1961. Contract AT(11-1)-578. 50p.

The boron–carbon equilibrium diagram was determined by x-ray, metallographic, and thermal analysis of sintered and arc-cast alloys. A single carbide having a range of solubility from approximately 9 to 20 at.% carbon and melting congruently exists in the system. The terminal solubility of carbon in boron is 0.1-0.2 at.%. The freezing reaction between boron and the carbide is a degenerate peritectic–eutectic reaction at the composition and melting temperature of elemental boron; there is a eutectic reaction at 29 at.% carbon and 2375°C. No allotropy of boron was observed. (auth)

26535 (BMI-1536) DEVELOPMENT OF NIOBIUM–URANIUM ALLOYS FOR ELEVATED-TEMPERATURE FUEL APPLICATIONS. John A. DeMastry, Donald P. Moak, Seymour G. Epstein, Arthur A. Bauer, and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Aug. 9, 1961. Contract W-7405-eng-92. 64p.

As a continuation of studies reported in BMI-1400, fabrication characteristics, physical and mechanical properties, and corrosion behavior in NaK, sodium, and water of niobium–uranium binary alloys containing up to 60 wt.% uranium were investigated. Alloys were cast by a skull melting and consumable and nonconsumable arc-melting methods. Fabrication difficulties with alloys containing greater than 25 wt.% uranium were related to coring-type microsegregation during casting. Tensile tests indicated 0.2% offset yield strengths of 16,880, 22,370 and 28,600 psi for niobium-4.38, -14.3, and -20 wt.% uranium alloys, respectively, at 2000°F. Additional tensile data were obtained for alloys from 1600 to 2400°F. Stresses to produce minimum creep rates of 0.001, 0.01, and 0.1%/hr at 1600, 1800, and 2000°F were also determined. Both tensile and creep strengths were found to be sensitive to oxygen content. All alloys appeared compatible with NaK at 1600°F and with sodium at 1500°F. In 600°F water, most of the alloys tested exhibited negligible weight changes after 336 days' exposure. Weight changes were greater after 140 days' exposure to 680°F water, but corrosion rates were considered satisfactory for a clad fuel. The thermal and electrical conductivities of niobium are lowered by the addition of uranium, while the thermal-expansion characteristics are essentially unaffected. Recrystallization temperatures for 90% cold-reduced niobium-4.38, -14.3, -20, -25.0, and -30 wt.% uranium alloys are 2300, 2300, 2400, 2300, and 2200°F, respectively. No appreciable effect of oxygen contents ranging from 100 to 1000 ppm was observed on the composition limits of the gamma immiscibility gap in the niobium–uranium system. (auth)

26536 (CNEN-52) MACRO AND MICROSTRUCTURAL CHANGES OF ALPHA-URANIUM UPON THERMAL CYCLING. R. Salice and F. N. Zein (Italy. Comitato Nazionale per L'Energia Nucleare, [Ispra]). June 1961. 25p.

Macro and microstructural changes of alpha-uranium were studied in three temperature ranges, 550 to 100°C, 630 to 100°C, and 630 to 400°C. These changes were found to develop readily in the 630 to 100°C range since the thermal cycling stresses are severer. Thermal cycling brings about subgraining, grain boundary roughening, and migration together with intragranular deformations. Pins with jagged grain boundary have a higher tendency to fragment more readily than these with smoother grain boundary. Double texture perfection upon thermal cycling is discussed and an interdependence between double texture and grain size is suggested. (auth)

26537 (CRGM-1008) THE AGGLOMERATION OF HYDROGEN IN HIGH-PURITY ALUMINUM AND ALUMINUM–MAGNESIUM ALLOYS. C. E. Ells and W. Evans (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1961. 34p. (AECL-1286)

The agglomeration was studied through the use of hydrogen introduced into the metal by cyclotron proton irradiation. Both growth and dispersal of the agglomerates were followed by metallographic techniques. During the cyclotron irradiation, agglomeration occurs at temperatures ≤100°C for hydrogen concentrations as low as 1 ppm. On heating at elevated temperatures, 300–600°C, intragranular agglomerates first coarsen and then disperse. The agglomerates formed at grain boundaries are much larger than the intragranular agglomerates; if the hydrogen concentration is >10 ppm, heating for 1 hour at 500°C results in extensive grain-boundary cracking. With increasing magnesium contents up to 2.9%, there is a slight tendency to decrease the amount of agglomerate formation. The hydrogen agglomerates are shown to inhibit grain growth. However, no inhibition of recrystallization was observed. The results show that grain boundaries are greatly preferred points of nucleation for bubble growth. The ability of hydrogen to enter aluminum at a free surface, combined with its diffusion rate at elevated temperatures, accounts both for growth and dispersal of the agglomerates. Irradiations at elevated temperatures gave results consistent with the explanation proposed for agglomerate behavior on post-irradiation heating. (auth)

26538 (CRGM-1016) CREEP OF ZIRCALOY-2 PRESSURE TUBES. I. LONGITUDINAL DIRECTION. L. G.

Bell (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1961. 47p. (AECL-1289)

Creep tests were done on longitudinal samples from two Zircaloy-2 pressure tubes at 300°C and stresses between 13,500 lb/in.^{2} and the ultimate tensile strength. Many of the tests were continued beyond 5000 hours. The requirement of a creep rate of 10^{-5}%/hr is met at a stress of 30,000 lb/in.^{2} at 300°C; under these conditions the rupture life is over 10 years. The stress-rupture requirement, 4/5 of the stress that will cause failure in 100,000 hr, is met at 24,000 lb/in.^{2} The difference in stress to produce a certain creep rate for Zircaloy-2 from different sources remains constant as the creep rate or stress goes down and is about the same as the difference in UTS at temperature. (auth)

26539 (DM61-191) A STUDY OF THE INFLUENCE OF HEAT TREATMENT ON MICROSTRUCTURE AND PROPERTIES OF REFRACTORY ALLOYS. Quarterly Report No. 5, March 1 to May 31, 1961. W. H. Chang (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). May 31, 1960. Contract AF33(616)-7125.

The studies on Mo-base alloys were completed with the determination of strength properties of heat-treated but non-worked Mo–TZC and Mo–TZ. The results show that at the appropriate temperatures, the tensile and rupture strengths of the annealed conditions can approach or even exceed those of the worked condition. This is made possible primarily by a fine, strain-induced precipitation which greatly enhances the rate of strain hardening of the annealed conditions during test. Strain-induced ageing was confirmed by microstructural examination as well as temperature and strain-rate dependencies. The annealed conditions show reversed temperature dependency and negative strain-rate sensitivity. The solutioning and ageing reactions of the Cb-base alloys F-48 and F-50 were investigated. In the presence of the interstitial contents, both alloys are typically precipitation-hardenable based on the changes in hardness and microstructure and incomplete phase-identification results. The F-48 alloy age-hardens extensively in the temperature range of 1800-2100°F, whereas the optimum ageing temperature range of F-50 is found to be 200-300°F lower. The lower solutioning and ageing temperature ranges of F-50 appear to result primarily from the Ti addition rather than its lower interstitial contents. (auth)

26540 (DMIC-Memo-122) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF NICKEL-BASE AND COBALT-BASE ALLOYS. D. A. Roberts (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Aug. 4, 1961. 3p.

Development of a new wrought Ni-base superalloy (Udimet-520) is reported which is suitable for jet-engine turbine blades and wheels operating at 1800°F. Also reported is a Ni-base high strength (Renè 41) fine wire suitable for wrapping pressure vessels and rocket motors. A tensile strength of 340,000 psi, yield strength of 220,000 psi, and 3% elongation in 10 in. are reported for this alloy. (J.R.D.)

26541 (GEAP-3355-2) STATUS REPORT ON CONTROL ROD MATERIALS RESEARCH AND DEVELOPMENT PROGRAM. W. C. Ballowe, A. N. Holden, W. J. Ozeroff, H. E. Williamson, and B. Weidenbaum (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Nov. 14, 1960. Contract AT(04-3)-189, Project Agreement No. 4. 138p.

Information on research and development for control rod materials to be used in thermal and epithermal reactors is presented. Information on design of control rods and control rod systems is also included. Progress in the areas of investigation is reported in physics, materials, and engineering. (J.R.D.)

26542 (HW-26873) THERMOGALVANIC EFFECTS BETWEEN ALUMINUM SLUG JACKETS. Y. B. Katayama (Hanford Works, Richland, Wash.). Feb. 2, 1953. Decl. Apr. 28, 1961. 6p.

The severity of attack of an aluminum slug jacket containing one or more spots decidedly hotter than the remainder of the jacket, conditions likely to exist in a poorly bonded slug, is investigated. A thermogalvanic cell is devised for heating the aluminum cans immersed in pile process water to various temperatures in a manner to simulate thermogalvanic couples believed to exist on fuel slug surfaces under pile operating conditions. The thermogalvanic currents and potential differences are measured and recalculated to rates of corrosion. Assuming uniform attack, a corrosion rate of 0.4 mil per month is calculated for a can maintained at 100°C and galvanically coupled to a similar can at 20°C. (N.W.R.)

26543 (HW-66693) TENSILE PROPERTIES OF IRRADIATED THORIUM. A. L. Bement, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1, 1960. Contract AT(45-1)-1350. 32p.

The effects of neutron exposure to 5×10^{21} nvt (1/8 at.% burnup) on the tensile properties and hardness of two lots of thorium differing in carbon content are described. The thorium lot, which was initially stronger by virtue of a higher carbon content, continued to be stronger throughout the range of exposures employed. Significant increases in strength and hardness result from an exposure of 2×10^{20} nvt. This exposure also induces a pronounced yield and greatly decreases strain hardenability. The yield point is reduced and eventually removed with increased exposure, which is believed to be due to dislocation glide impedance caused by fission products. Brittle fracture at less than 4% elongation occurs with burnups greater than 1.0 at.%. Effective recovery of irradiation damage can be obtained by annealing at 750°C; however, some nonrecoverable damage occurs with burnups greater than 0.005 at.%. The effects of neutron irradiation on the mechanical properties of thorium and uranium are compared and discussed. (auth)

26544 (KAPL-2143) FUNDAMENTALS OF THERMAL CONDUCTIVITY AT HIGH TEMPERATURES. A. E. Powers (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 7, 1961. Contract W-31-109-Eng-52. 34p.

The fundamentals of thermal conductivity in metallic and nonmetallic materials at elevated temperatures are briefly reviewed. The subjects discussed are the mechanisms of thermal conductivity in metallic and nonmetallic materials, conductivity in solid solutions, conductivity in multiphase aggregates, radiant heat transfer, effect of neutron irradiation, and the classification of the methods of measurement of thermal conductivity. Reference is made to a modified Wiedemann-Franz relation that enables reasonable calculation of thermal conductivity from electrical conductivity in metallic materials. Methods are outlined for calculating conductivity in dispersions containing spherical and nonspherical particles and coated particles. (auth)

26545 (NARF-61-24T) MATERIALS DATA FOR NUCLEAR SYSTEMS. W. Q. Hullings (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). July 17, 1961. Contract AF33(600)38946. 182p. (FZK-9-162)

A compilation was made of significant information on the properties of engineering materials and their use in nuclear systems. The information is divided into three main

parts: shielding materials, reactor materials, and materials at extreme temperatures. (auth)

26546 (NASA-TN-D-1053) STABILITY OF TITANIUM NITRIDE AND TITANIUM CARBIDE WHEN EXPOSED TO HYDROGEN ATOMS FROM 298° TO 1950°K. Warren H. Philipp (National Aeronautics and Space Administration, 1961. 15p.

No appreciable reaction was observed from 298 to 1950°K when TiN or TiC was exposed to H atoms at 10^{-4} atm pressure. At the lower temperatures, thermodynamic calculations show that such reactions are favored; however, the reaction rates should be low because of the kinetics, since the reaction product Ti, which is a good catalyst for H atom recombination, does not readily volatilize. Also determined were the rates of decomposition of TiN and TiC in vacuum and in molecular H_2 at 10^{-3} atm pressure. Thermodynamic computations support the experimental data on the evaporation rates in vacuum and the fact that TiN and TiC are not expected to react appreciably with molecular H_2 from 298 to 2000°K. (auth)

26547 (NP-9515) A SOLVENTLESS LIQUID ADHESIVE WHICH POLYMERIZES BY CATALYTIC ACTION OF SURFACES TO BE BONDED. Final Report, May 28, 1959–May 28, 1960. B. David Halpern, Jack Dickstein, Rose-Marie Hoegerle, and George Kitazawa (Bordon Chemical Co. Central Research Lab., [Philadelphia]). Contract DA-36-034-ORD-2928-RD. 69p.

Activities in a program are described for preparation of fast self-curing adhesive systems for use with metals. Preparation and evaluation of systems such as those in the areas of substituted acrylates and methacrylates, chelating liquid monomers, and miscellaneous vinyl monomers were investigated. A complete list of monomeric systems which were investigated is included. (J.R.D.)

26548 (NP-10485) HARD PARTICLE STRENGTHENING OF REFRACTORY METALS FOR HIGH TEMPERATURE USE THROUGH INTERNAL OXIDATION. Progress Report No. 3, May 1, 1961–June 30, 1961. A. S. Bufferd, K. M. Zwilsky, and N. J. Grant (New England Materials Lab., Inc., Medford, Mass.). July 31, 1961. Contract NOw 61-0316-c. 10p.

The recrystallization temperature of two internally oxidized Mo–1.5 Ti alloys was determined. The alloy extruded with the lower reduction ratio of 4 to 1 had a recrystallization temperature of 2650°F whereas the alloy extruded with a 6 to 1 ratio recrystallized at about 2400°F. Stress-rupture tests in argon at 2200°F of three internally oxidized alloys recrystallized during Dynapak extrusion gave lower properties than were obtained for stress-relieved arc cast Mo–1.5 Ti. (auth)

26549 (NP-10564) PROPERTIES OF MAGNESIUM–THORIUM ALLOYS, AN ANNOTATED BIBLIOGRAPHY. William L. Hollister, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). June 1961. 22p. (SB-61-29)

A bibliography of 48 references, most with abstracts, is presented on magnesium–thorium alloys with emphasis on short-time temperature curves and temperature effects on the mechanical and physical properties and fabrication techniques. (D.L.C.)

26550 (NP-10577) DEVELOPMENT AND TESTING OF ELECTRODEPOSITED CERMETS. John Huminik, Jr. and Giovanni G. F. Bargero (Value Engineering Co., Inc., Alexandria, Va.). [nd]. 23p.

Research being conducted on coatings composed of a ceramic in a chromium matrix and electrodeposited on graphite and refractory materials is described. The results of test firing small metal nozzles coated in this manner are also given. It is stated that the zirconium boride–chromium coating (Valcoat 12) is the best available coating. Calculations are given for correlating test motor results with actual rocket motor parameters. (D.L.C.)

26551 (NP-10583) INVESTIGATION OF THE MECHANICAL PROPERTIES OF ULTRA-PURE TUNGSTEN. Final Report, January 1, 1958 to June 30, 1961. D. P. Ferriss, R. M. Rose, and J. Wulff (Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.). June 30, 1961. Contract DA-19-020-ORD-4543. 110p. (AROD-1970: 1,2, 3,4 & 5).

The effects of orientation on the stresses, activation energies, and activation volumes for yielding the plastic flow of W single crystals were investigated. Crystals with tensile axes near the [110] direction were ~3 times as strong as [100] crystals. The activation energy was ~0.5 ev at all orientations. The data are explained on the basis of dislocation networks in the body-centered cubic lattice. Tension tests were carried out on Ta single crystals, and the results indicate inhomogeneous deformation at low temperatures. Tension test investigations were also conducted on Ta–W alloy single crystals in the ductile-brittle transition region. Results are reported for studies of void formation in W above 2800°C. An electron beam zone melting apparatus is described. (D.L.C.)

26552 (NRL-5568) RADIANT TRANSFER OF HEAT AND THE THERMAL CONDUCTIVITY OF FLINAK (SALT "A"). C. T. Ewing, J. R. Spann, and R. R. Miller (Naval Research Lab., Washington, D. C.). Sept. 16, 1960. 7p.

Thermal conductivity coefficients of flinak [salt "A" (11.5 mole % NaF, 42.5% KF, and 46.0% LiF)] from 490 to 850°C previously reported are shown to be only apparent values which result from the combined transfer of heat by radiation and conduction. The apparent coefficients were found to be a function of the thickness of the liquid layer and other parameters of the apparatus in which the measurements were made. The radiant and molecular components which contribute to the total transfer of heat through the material were identified in semitheoretical equations which permit the solution of the practical heat-transfer problems. One presentation of the heat flow through flinak, and perhaps other organic liquids, is: $q/A = k_m \Delta t/\Delta x + C_t \sigma[(T + \Delta t)^4 - T^4]$, where q is the rate of heat flow between two parallel infinite black surfaces, A is the area of heat flow, k_m is the coefficient for conduction, Δt is the temperature difference between the surfaces, Δx is the thickness of the liquid, C_t is the transmission coefficient for the liquid thickness, σ is the Stefan-Boltzmann constant, and T is the absolute temperature of the cooler surface. For flinak, k_m was found to be 0.006 watts/cm-°C. The value of C_t was initially near unity for a 1-inch thickness of the pure salt but dropped to 0.5 or lower following reaction of the salt and the container. (auth)

26553 (NUMEC-P-40) DEVELOPMENT OF PLUTONIUM BEARING FUEL MATERIALS. Progress Report, July 1–September 30, 1960. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Oct. 17, 1960. Changed from OUO Jan. 4, 1961. Contract AT(30-1)-2389. 43p.

Twenty-two glove boxes were installed to the ventilation system and transport tunnel. The installation of equipment set-ups and checkout of operations prior to sealing the boxes is being emphasized. Studies on uranium dioxide preparation and characterization was continued as prelude to working with plutonium. A non-flammable mixture of

5% hydrogen and 95% nitrogen was shown with good results to be of use in both reduction and sintering operations. Basic studies were begun on mechanical packing for determining the fuel particle size distribution leading to optimum-packing or densification. It was shown that the oxide particle characteristics are dependent on the acidity of the feed mixture. (B.O.G.)

26554 (ORO-366) COLUMBIUM ALLOY CLAD URANIUM CARBIDE FUEL ELEMENT. Final Report, May 1, 1959–April 30, 1960. Metals Research Laboratories Technical Report 60-46. J. J. Finley, M. Korchynsky, and S. Sarian (Union Carbide Metals Co., Niagara Falls, N. Y.). Sept. 1, 1960. 91p. Contract AT(40-1)-2559.

The formation of uranium carbide by the reaction of uranium metal with methane was investigated in detail. The conditions necessary to attain a stoichiometric composition are outlined, and the possible mechanisms of compound formation are discussed. The progress of carburization can be controlled by matching the particle size of uranium (produced by thermal decomposition of UH_3), reaction temperature and time, and methane concentration. Several powder metallurgical techniques were employed to form dense uranium monocarbide compacts. Starting with fine powders (mean particle size of several microns), densities between 92 and 95% of theoretical were obtained by cold-pressing and sintering at 1700 to 1900°C. Compacts with zero porosity were produced by vacuum hot-pressing below 1600°C uranium carbide powders in tungsten dies. Similar densification was observed after hot-swaging uranium carbide powder canned in a columbium-base alloy. The applicability of slip casting was evaluated in a series of preliminary experiments. The compatibility of uranium monocarbide with several columbium-base alloys, contemplated as cladding material, was studied using a picture-frame technique. No interaction was detected metallographically and by microhardness measurements after 100 hours exposure at 1100°C in an argon atmosphere. Various analytic procedures are presented. (auth)

26555 (TID-6506(Suppl.)) SUMMARIES OF FUELS AND MATERIALS DEVELOPMENT PROGRAMS. (Division of Reactor Development. Fuels and Materials Development Branch, AEC). Apr. 1961. 208p.

The objective of the individual research projects of the fuel and materials development programs of the AEC are summarized. Contractors are listed alphabetically and a subject index is included. A list of reports issued, if available, is provided for each contract. (N.W.R.)

26556 (TID-12712) FUNDAMENTALS OF SINTERING–V. FIFTH ANNUAL PROGRESS REPORT, JULY 1, 1959 THROUGH JUNE 30, 1960. J. Brett and L. Seigle (General Telephone and Electronics Labs. Inc., Bayside, N. Y.). Apr. 21, 1961. Contract AT(30-1)-2102. 31p. (SEP-257; TR-61-101.5)

Experiments to evaluate the influence of impurities and atmospheres on the activity of grain boundary vacancy sinks were carried out in nickel, copper, and dezincified brass powder. In the absence of extraneous effects, the sintering rates appeared to be surprisingly independent of either the atmosphere—vacuum, argon, or hydrogen—or the presence of a surface active impurity, sulfur. The latter indicates that in powder compacts segregated impurities have no pronounced effect upon grain boundary vacancy absorption. Compacts of 99.6% pure hydrometallurgically produced copper powder did not densify in vacuum, due apparently to the entrapment of gas in the pores. (auth)

26557 (TID-13307(Pt.VII)) STRESS-STRAIN CHARACTERISTICS OF MATERIALS AT HIGH STRAIN RATES. PART VII. FURTHER STUDIES OF DYNAMIC COMPRESSIVE YIELD STRESSES. William L. Guyton (Texas. Univ., Austin. Structural Mechanics Research Lab.). June 1961. For Sandia Corp. Contract AT(29-2)-621. 59p. (SCDC-2361)

Definite conclusions regarding the effects of specimen configuration and related variables on the dynamic compressive yield stress of copper have not been forthcoming previously because of considerable variation in experimental results. The variations are attributed to data interpretation techniques, lateral restraint from radial friction, strain hardening caused by machining cold work, and impurities in the material. Investigation of these factors using pure copper indicates: radial friction on specimen faces definitely affects the dynamic yield stress for low length-to-radius (L/R) ratios; the effects of machining cold work are negligible; and an averaging curve data-reduction technique is necessary to obtain reproducible results. Further measurements, using a suitable lubricant to reduce radial friction and the averaging curve technique for data interpretation, consistently indicate that dynamic yield stress increases for increase in specimen radius and decrease in specimen length. (auth)

26558 (UCRL-6502-T) BERYLLIUM OXIDE–ITS PROPERTIES AND APPLICATION IN NUCLEAR REACTORS. A. J. Rothman (California. Univ., Livermore, Lawrence Radiation Lab.). Contract W-7405-eng-48. 41p.

The physical, mechanical, chemical, and nuclear properties of beryllium oxide (BeO) are studied. Attention is then given to the technology, toxicity, preparation from ore, and methods of fabricating BeO. The application of BeO in the field of nuclear reactors, and its future potential are outlined. (T.F.H.)

26559 (USNRDL-TR-518) THERMAL DIFFUSIVITY MEASUREMENTS ON METALS AT HIGH TEMPERATURES. R. L. Rudkin, R. J. Jenkins, and W. J. Parker (Naval Radiological Defense Lab., San Francisco). June 27, 1961. 19p.

A flash method for the measurement of the thermal diffusivity of metals up to 1800°C is described. A high intensity short duration light pulse is absorbed in the front surface of a thermally insulated specimen a few millimeters thick heated in an induction furnace and the resultant temperature history of the rear surface is measured by a lead sulfide cell, displayed on an oscilloscope, and photographed by a Polaroid Land camera. The thermal diffusivity of the material is determined from this temperature versus time curve, provided the theoretical boundary conditions are experimentally satisfied. Measurements of the thermal diffusivity of Armco iron, molybdenum, and titanium were made. (auth)

26560 (WADD-TR-60-901) ION PROPULSION WORKING FLUID REQUIREMENTS FOR USAF. Period Covered, April to July 1960 and November 1960. James H. L. Lawler (Wright Air Development Div. Materials Central, Wright-Patterson AFB, Ohio). Dec. 7, 1960. 25p.

Some of the anticipated requirements for an ion engine working fluids are derived by the consideration of missions expected to be of interest, the probable systems which will produce the power, and handling needs. (auth)

26561 (AEC-tr-4451(p.193-205)) STUDY OF EQUILIBRIUM PHASE DIAGRAM OF THE SYSTEM Co–Cr–Ti. B. G. Livshits and Ya. D. Khorin. Translated from Zhur. Neorg. Khim., 3: 685-93(1958).

Phase studies were carried out on the Co–Cr and Co–Ti binary systems and on the Co–Cr–Ti ternary system in the Co-rich region at 750, 900, and 1050°C. It was found that the solubility of Cr and Ti in the ternary system in-

creases with temperature and that Co_2Ti dissolves 30 to 35% Cr to form a ternary Laves phase corresponding to $(Co,Cr)_2Ti$. A ternary compound was found with the approximate composition of Co_4Cr_2Ti. (D.L.C.)

26562 (AEC-tr-4451(p.298-309)) PHASE DIAGRAMS OF ALLOYS OF LANTHANUM WITH CERIUM, AND LANTHANUM WITH CALCIUM. E. (Ye.) M. Savitskii (Savitskiy) and V. F. Terekhov. Translated from Zhur. Neorg. Khim., 3: 756-62(1958).

Phase diagrams were constructed for the La–Ce and La–Ca systems. La and Ce are mutually soluble in both liquid and solid states. In the La–Ca system, a large liquid layer forms from 12 to 90% Ca at the monotectic temperature of 760 to 765°C. The solubility of La in Ca and of Ca in La at the eutectic temperature of 705°C does not exceed 3 to 5%. (D.L.C.)

26563 (AEC-tr-4451(p.330-41)) STUDY OF THE PHASE DIAGRAMS OF THE ALLOYS TITANIUM–CHROMIUM, TITANIUM–TUNGSTEN, AND TITANIUM–CHROMIUM–TUNGSTEN, PREPARED BY THE METHOD OF POWDER METALLURGY. Yu. A. Bagaryatskii (Bagaryatskiy), G. I. Nosova, and T. V. Tagunova. Translated from Zhur. Neorg. Khim., 3: 777-85(1958).

Phase diagrams were constructed for the binary systems Ti–Cr and Ti–W and for the ternary system Ti–Cr–W. (D.L.C.)

26564 (AEC-tr-4768) DIFFUSION OF ALUMINUM DURING THE TRANSFORMATION UAl_3–UAl_4 IN THE SOLID STATE. R. Boucher. Translated by M. S. Feldman for Savannah River Lab. from p.111-17 of "Symposium on Solid State Diffusion, Saclay, July 3-5, 1958." 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 7826.

26565 (CEA-tr-X-289) LE VERRE COMME PROTECTION CONTRE LE RAYONNEMENT ELECTROMAGNETIQUE DE LA MATIERE AVEC CONSIDERATIONS SPECIALES SUR LE RAYONNEMENT EN RAPPORT AVEC LE PROCEDE NUCLEAIRE. (Glass as Protection Against Electromagnetic Radiation from Matter with Special Considerations on Radiation with Respect to Nuclear Processes). Milota Fanderlik. Translated into French from Ministerstvo Spotrebniko Prumyslu. Rada I, 1956, p.9-41. 76p.

A review is given of the different types of radiation, and the relationship between the radiations and the composition of the glass is shown. (J.S.R.)

26566 (NP-tr-678) EFFECT OF PLASTIC DEFORMATION ON THE ELASTIC PROPERTIES OF NICKEL–CHROME ALLOYS. T. Ya. Benieva. Translated from pages 62-7 of "Primeneniye Ul'trazvykovykh Kolebaniy Dlya Issledovaniya Svoystv, Kontrolya Kachestva i Obrabotki Metallov i Splavov" (A Publication of the Publishing House of the Academy of Sciences, Kiev, 1960). 7p.

Results obtained in a study of plastic deformation effects on the speed of sound in Ni–Cr alloys are presented. The elastic properties of these alloys are examined by measuring the propagation rate of longitudinal and lateral ultrasonic oscillations in initial and deformed states. The ultrasonic impulses were determined with a special impulse installation. (J.R.D.)

26567 (NP-tr-719) THE HARDNESS OF CERTAIN NIOBIUM-BASE ALLOYS AT ELEVATED TEMPERATURES. I. I. Kornilov and R. S. Polyakova. Translated from Atomnaya Energ., 10: No. 2, 170-2(1961). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 14764.

26568 (NP-tr-722) STRUCTURE AND PROPERTIES OF NIOBIUM–ALUMINUM ALLOYS. V. V. Baron and E. (Ye.) M. Savitskii (Savitskiy). Translated from Zhur. Neorg. Khim., 6: No. 1, 182-5(1961). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 14791.

26569 (NP-tr-725) A STUDY OF EQUILIBRIUM IN A ZIRCONIUM–NITROGEN SYSTEM AT HIGH TEMPERATURES AND THE DEPENDENCE OF THE FREE ENERGY OF FORMATION OF ZrN_x ON ITS COMPOSITION AND STRUCTURE. E. (Ye.) I. Smagina, V. S. Kutsev, and B. F. Ormont. Translated from Trudy Nauch.-Issledovatel.' Fiz.-Khim. Inst. im. L. Ya. Karpova, No. 2, 118-31(1959). 27p.

A method is developed for investigating equilibria in the ZrN_x–N_2 system at temperatures up to 2800°K. An apparatus for this investigation is also developed for synthesizing zirconium nitrides of different compositions and for studying the conditions of their formation. Nitrides were obtained for x equal 0.56 to 1.0, they were burned in a calorimetric bomb, and their heats of formation were determined. The chemical equilibrium is studied in the temperature range 1900 to 2700°K and the pressure range 0.01 to 300 mm Hg. At each stage of the work the products were subjected to chemical and x-ray phase analysis. (N.W.R.)

26570 (RAE-Lib-Trans-940) PYROLYTIC CARBON DEPOSITED ON GRAPHITE. (Pyroltisch Abgeschiedene Hartkohleschichten auf Graphit). W. Meier, W. Hugi, and R. Scheidegger. Translated by C. Ranson for Royal Aircraft Establishment from Schweiz. Arch. angew. Wiss. u. Tech., 26: 29-38(1960). 18p. (AD-254875)

Very hard carbon layers are deposited onto graphite by pyrolysis of organic gases. By means of electron microscopy, x-ray experiments, and density measurements, it is shown that the nature of the pyrolyzed gas (hydrocarbons, oxygen containing compounds, and carbon tetrachloride) results in no significant differences in the layers. The layers are not graphitized; they graphitize on heating in vacuo at 2300 to 2400°C. (P.C.H.)

26571 THE BEHAVIOR OF FISSION PRODUCTS CAPTURED IN GRAPHITE POWDER BY NUCLEAR RECOIL. III. DIFFUSION OF IODINE-133 AND TELLURIUM-132 IN GRAPHITE AT HIGH TEMPERATURES. Seishi Yajima, Sumio Ichiba, Yuichiro Kamemoto, and Koreyuki Shiba (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 493-7(Apr. 1961). (In English)

The diffusion of iodine-133 and tellurium-132 in graphite at high temperatures is described. Isothermal curves of the diffusion in four kinds of graphite are illustrated. It is shown that the rates of diffusion in natural graphite, which has only a few trapping centers, are greater than in artificial graphite which has many trapping centers. The gamma-ray spectra of the isotopes in a copper trap are illustrated. The high-velocity diffusion in a fuel element of graphite and uranium dioxide results in the release of the fission products emitting delayed neutrons that are important in reactor control. (N.W.R.)

26572 INVESTIGATION OF THE SYSTEM BERYLLIUM-BORON. Clarence L. Hoenig, Carl F. Cline, and Donald E. Sands (Univ. of California, Livermore). J. Am. Ceram. Soc., 44: 385-9(Aug. 1961). (UCRL-5855)

Mixtures of beryllium and boron powders were reacted under argon at elevated temperatures. X-ray, single-crystal, and powder diffraction analyses, chemical analyses, and Knoop micro-hardness measurements were made. Melting-point ranges were established for compounds of

reasonable purity. One compound was identified. Beryllium diboride (BeB_2) has a hexagonal unit cell. Its hardness was 3180 ± 100 (H_{K100}), and its melting point was greater than 1970°C. Beryllium hexaboride (BeB_6) has a tetragonal unit cell, a hardness of 2577 ± 75 (H_{K100}), and a melting point between 2020° and 2120°C. An anisotropic unknown phase existed whose Be : B ratio was between 6 : 1 and 2 : 1 and whose hardness ranged between 623 and 917 (H_{K25}), depending on orientation. A eutectic between beryllium and the unknown phase was observed at 972° ± 15°C. (auth)

26573 STUDIES IN LITHIUM OXIDE SYSTEMS: XI. $Li_2O-B_2O_3-P_2O_5$. T. Y. Tien and F. A. Hummel (Pennsylvania State Univ., University Park). J. Am. Ceram. Soc., 44: 390-4(Aug. 1961).

The glassforming region in the system was roughly outlined and liquidus data were obtained for the three joins $LiPO_3-BPO_4$, $Li_4P_2O_7-BPO_4$, and $Li_3PO_4-Li_2B_4O_7$. Compatibility relations for the ternary subsystems $Li_4P_2O_7-BPO_4-P_2O_5$ and $Li_2O-Li_3PO_4-Li_2B_8O_{13}$ were established. Two ternary compounds with the probable compositions $22Li_2O \cdot 11B_2O_3 \cdot 13P_2O_5$ and $2Li_2O \cdot 3B_2O_3 \cdot P_2O_5$ were detected. (auth)

26574 EFFECT OF ENVIRONMENT AND SURFACE CONDITION ON STRENGTH OF LITHIUM FLUORIDE SINGLE CRYSTALS. W. L. Phillips, Jr. (E. I. du Pont de Nemours & Co., Wilmington, Del.). J. Am. Ceram. Soc., 44: 395-400(Aug. 1961).

Lithium fluoride single crystals which were annealed in various gases, abraded with papers of different grits, etched, polished, and coated with metals before testing were deformed in compression. Another series of tests was performed in which the specimens were deformed while immersed in mineral, fatty, dicarboxylic, and tricarboxylic acids, xanthates, aerofloats, amines, water, and bases. Attempts to correlate the observed mechanical properties and the environment or surface condition were partly successful. The appearance of the stress lines and the fracture characteristics of these crystals were also investigated. (auth)

26575 DIELECTRIC PROPERTIES OF ZIRCONATES. H. Stetson and B. Schwartz (Radio Corp. of America, Somerville, N. J.). J. Am. Ceram. Soc., 44: 420-1(Aug. 1961).

The dielectric constants and dissipation factor of Ca, Sr, Ba, La, Nd, and Sm zirconates are reported as a function of temperature. The optimum firing characteristics, average absorption, specific gravity, and dielectric properties are given for each. A sample of each material was also checked by x-ray diffraction for the phases present. The temperature coefficients of the alkaline earth zirconates change from negative for Ba to positive for Ca and Sr zirconates, and for the rare earth zirconates from negative for La to positive for Sm or Nd. (P.C.H.)

26576 NIOBIUM SOLID ELECTROLYTIC CAPACITORS. N. Schwartz, M. Gresh, and S. Karlik (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Electrochem. Soc., 108: 750-8(Aug. 1961).

The suitability of niobium as the anode for solid electrolytic capacitors was investigated. Field crystallization of the amorphous niobium oxide film was found to be a determining factor for the properties of these capacitors. Purity of the porous anodes as dependent on the sintering conditions, formation temperature and voltage, and formation electrolytes, parameters all known to control the initiation of crystallization, were correlated with the initial and life test properties of these capacitors. The initial properties of niobium solid electrolytic capacitors prepared under optimum conditions compare favorably with equivalent tantalum components. However, with the current purity of niobium powder, only units with operating voltages up to 20 v survive a life test at 85°C, with the failures of capacitors rated at higher voltages attributed to the partial crystallization of the amorphous film during formation. (auth)

26577 TRANSPORT NUMBERS IN PURE FUSED CESIUM CHLORIDE. Edward D. Wolf (Ames Lab., Ames, Iowa). J. Electrochem. Soc., 108: 811-12(Aug. 1961). (IS-279)

The chloride ion transport number in pure fused CsCl was redetermined, using a modified and more refined experimental procedure. The transport number was found to be 0.435 ± 0.008 at 705°C. No temperature dependence was found. (P.C.H.)

26578 BERYLLIUM PROCESSING BY POWDER METALLURGY. K. G. Wikle and V. C. Potter (Brush Beryllium Co., Elmore, Ohio). J. Metals, 13: 537-44 (Aug. 1961).

Description is given for the powder metallurgical processing of beryllium into fine-grained forms from which finished shapes are made. Emphasis is given to the vacuum-hot-press-machine process which is used for the majority of beryllium parts being made today. (auth)

26579 METALLOGRAPHIC STUDY OF STRUCTURAL STRINGERS IN ZIRCALOY-2. Pierre A. Jacquet (Centre d'Etudes Nucléaires, Saclay, France). J. Nuclear Materials, 4: 1-29(May-June 1961). (In French)

The new technique of localized electrolytic polishing was applied to the study of the stringers in Zircaloy-2. These defects were detected exclusively in forged billets and rolled sheets made from ingots which were cast from alloy melted in consumable arc furnaces in an argon atmosphere. Products made from ingots produced by vacuum melting do not contain stringers. The variation of the micrographic appearance with the polishing conditions (primarily the nature of the electrolyte), and the influence of anodic oxidation tend to show that structural stringers are not a form of porosity inherited from the ingot. They are associated with chemical heterogeneities (an unidentified intermetallic constituent, oxides) resulting from the thermal conditions of melting and from impurities in the atmosphere. A confusion between physical discontinuities and correspondingly shaped features of the microstructure can arise from the corrosive action of the etching reagents on mechanically polished surfaces. Comparison of the structure of billets and sheets, x-ray analysis, and the results of observations by others permit an interpretation of the effects of hot rolling. The appearance of macroscopic defects results from the inflation, by oxygen, of filaments at the surface. Moreover, the insolubility of the relevant oxides accounts for the known fact that a prolonged treatment at high temperature can eliminate the concentration gradients responsible for so-called corrosion-stringers, while leaving unaffected those filaments which are formed by oxide segregation. (auth)

26580 THE ARCING BEHAVIOUR OF METALS IN CONTACT WITH A LOW ENERGY HYDROGEN PLASMA. L. B. Griffiths (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 4: 30-6 (May-June 1961). (In English)

Previous work was extended under highly reproducible conditions in an attempt to ascertain the mechanism of arc initiation. Results show that only quite small potential dif-

ferences, of the order of 10 volts, need exist between parent metal and inclusions therein in order to initiate arcing. The proposed mechanism leads to the production of a vapor of impurity atoms above the cathode surface and is based upon the electrical properties of the interface between metal and inclusions which are viewed as being semi-conducting in character. (auth)

26581 TRANSFORMATION KINETICS OF GAMMA-PHASE URANIUM–MOLYBDENUM–NIOBIUM ALLOYS. W. M. Justusson (Ford Motor Co., Dearborn, Mich.). J. Nuclear Materials, 4: 37-45(May-June 1961). (In English)

Some properties of gamma phase uranium-base molybdenum–niobium ternary alloys are described. Transformation kinetics of the gamma phase at 550, 500, and 450°C were followed primarily by resistometric techniques. Molybdenum rich alloys with small additions of niobium were found to have the most sluggish transformation kinetics. Duplex gamma phase alloys have lower thermal stability than single phase alloys. Densities and electrical resistivities of alloys quenched from 1000°C were measured. Duplex phase alloys were determined by resistometric measurements and metallographic examination. (auth)

26582 THE SOLID SOLUBILITY OF ZIRCONIUM IN α-THORIUM. R. H. Johnson and R. W. K. Honeycombe (Sheffield Univ., Eng.). J. Nuclear Materials, 4: 59-65 (May-June 1961). (In English)

Metallographic and x-ray diffraction methods were used to determine the solid solubility of zirconium in α-thorium. The solubility changes from 5.0 at. % at 650°C to 9.9 at. % at 920° C and reaches a maximum of 10.2 at. % in the range 940–1000°C. Data for both iodide and electrolytic thorium are given. (auth)

26583 THE SOLUBILITY OF ZIRCONIUM IN α-THORIUM. D. S. Evans and G. V. Raynor (Univ. of Birmingham, Eng.). J. Nuclear Materials, 4: 66-9(May–June 1961). (In English)

The lattice spacings of seven thorium-rich thorium–zirconium alloys were measured after quenching from 900, 750, 675, and 550°C. The solid solubility of zirconium falls from 9.4 at. % at 900°C to 2.9 at. % at 550°C. From the linear relationship between $\log_{10}$ S and 1/T°K where S is the solubility in at. %, the solubilities at 920 and 25°C may be calculated as 9.84 and about 0.002 at. %, respectively. (auth)

26584 IMPERFECTIONS IN NATURAL GRAPHITE. J. A. Hedley and D. R. Ashworth (C. A. Parsons & Co., Ltd., Newcastle-upon-Tyne, Eng.). J. Nuclear Materials, 4: 70-8(May-June 1961). (In English)

Thin films of a natural graphite, Madagascar flake, examined by electron microscopy revealed the presence of flat graphite sheets whose basal planes were predominantly normal to the electron beam. Dislocations lying in the basal planes were frequently observed, the estimated mean density being $10^9/cm^2$. Graphite has a high incidence of stacking faults. Basal plane dislocations frequently split into partials which bound ribbons of stacking fault, 650–1000 Å wide. If these ribbons of stacking fault occur at the same level in the film they often interact to form stable networks. From measurements of the radius of curvature of dislocation nodes, the stacking fault energy was estimated to be approximately 0.25 erg/cm^2. Because of the fortuitous relative rotation of graphite sheets, Moiré patterns were observed with dislocations imaged as extra inserted fringes. (auth)

26585 SOME STUDIES OF GAS EVOLUTION FROM GRAPHITE AND URANIUMOXIDE/GRAPHITE COMPACTS AT TEMPERATURES UP TO 1250°C. J. J. Lawrance and D. J. O'Connor (Australian Atomic Energy Commission, Lucas Heights, New South Wales). J. Nuclear Materials, 4: 79-89(May-June 1961). (In English)

The quantities and compositions of gases evolved from uranium oxide/graphite compacts were measured at temperatures up to 1250°C after prior degassing for 17 hours at 200°C. Similar studies were made on graphite and four uranium oxides, $UO_{2.008}$, $UO_{2.014}$, $UO_{2.33}$, and U_3O_8. In agreement with thermodynamic data, reduction stopped at the $UO_{2.0}$ stage for all four oxides and all oxide/graphite ratios used (1 : 1 – 1 : 70 M). The quantity of gas (CO_2 + CO) evolved from the oxide/graphite compacts was dependent on the oxygen content of the uranium oxide in excess of the ratio O/U = 2.00. (auth)

26586 NEW METALLOGRAPHIC TECHNIQUES FOR THE EXAMINATION OF URANIUM, URANIUM ALLOYS AND URANIUM DIOXIDE. J. F. R. Ambler and G. F. Slattery (United Kingdom Atomic Energy Authority, Springfields, Lancs, Eng.). J. Nuclear Materials, 4: 90-9(May-June 1961). (In English)

An attack-polish reagent was developed for the metallographic preparation of uranium alloys and uranium dioxide. The reagent consists of a slurry of hydrogen peroxide (30 wt.%) and 5% γ-alumina. Polishing is carried out on a polythene lap covered with terylene velvet. The method has many advantages over the standard electro-polishing techniques used for uranium and uranium alloys. A new electrolytic etching technique described, for the study of the grain structure of uranium and uranium alloys using bright field illumination, provides a useful alternative to polarized light methods. The reagent is composed of ammonium persulphate/glycerol/water. A new stain etch using hydrogen peroxide (30 wt.%) was developed for the general examination of grain size and distribution in uranium dioxide sintered compacts and is also ideal for studying duplex UO_2 and U_4O_9 phase structures. The results obtained by these new techniques are discussed, using specific metallographic structures as examples. (auth)

26587 GRAIN SHAPES IN QUENCHED URANIUM. B. R. Butcher, D. C. Minty, K. E. G. Meredith, and H. Strong (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 4: 100-8(May-June 1961). (In English)

Details are given of some experiments on the grain shapes and sizes produced in two grades of uranium, one with and one without small solute additions, after quenching from temperatures in the range of the β and γ phases. A tentative theory of the grain shapes produced by β quenching these materials is put forward. (auth)

26588 THE EFFECT OF DISSOLVED OXYGEN ON THE TERMINAL SOLUBILITY OF HYDROGEN IN ALPHA ZIRCONIUM. A. Brown (C. A. Parsons and Co., Ltd., Newcastle-upon-Tyne, Eng.) and D. Hardie. J. Nuclear Materials, 4: 110-12(May-June 1961). (In English)

Using a high vacuum apparatus, equilibrium pressure concentration isotherms were plotted for zirconium containing 1200, 4200, and 5600 ppm oxygen in the temperature range 530 to 790°C. The results are plotted as the logarithm of the equilibrium pressure against reciprocal temperature for solutions of various hydrogen concentration. Results obtained clarify interpretation of microstructures obtained in α zirconium after corrosion in high temperature water or steam. Preliminary investigations by means of vacuum dilatometry at temperatures below the eutectoid indicate that the terminal solubility is also increased in that region. (P.C.H.)

26589 THE LANTHANUM–BORON SYSTEM. Robert W. Johnson and A. H. Daane (Ames Lab., Ames, Iowa). J. Phys. Chem., 65: 909-15(June 1961). (IS-151)

From thermal, metallographic, x-ray, and electrical resistance data a phase diagram is proposed for the lanthanum–boron system. Two compounds are formed, LaB_4 and LaB_6. The former has a very narrow range of homogeneity and decomposes peritectically at 1800 ± 15°. The crystal system is tetragonal, and the compound is a metallic type conductor. LaB_6 exists in the range 85.8 to 88% boron, melts above 2500°, and has a simple cubic lattice. The color of the compound changes with composition, going from purple to a bright blue with increasing boron content. The addition of boron to lanthanum has no measurable effect on the melting point or transition points of the metal. The addition of lanthanum to boron appears to have very little effect on the melting point of boron. There is metallographic evidence for an allotropic transformation in boron above 2100°. Evidence also is given for a new compound CaB_6, which appears to be isomorphous with LaB_6. (auth)

26590 PHASE STRUCTURE AND HEAT RESISTANCE OF ALLOYS. I. L. Mirkin and V. Z. Tseitlin (Central Research Inst. of Heavy Machinery, USSR). Metalloved. i Termicheskaya Obrabotka Metal., No. 2, 2-11(Feb. 1961). (In Russian)

Plastic deformation and creep of metals are gradual processes. Their rate depends on the applied stresses and can be determined from the chemical composition and the phase diagram of the material. The lattice bond energy of Al in creep studies in independent of the heat treatment but is a function of the effective stress. Ferrous metals do not have a noticeable long-range resistance against plastic deformation at temperatures beyond 630°C, even if the solid solution $Fe_\alpha(C)$ is highly alloyed with elements which strongly increase the strength of the interatomic bonds. In order to increase the strength at higher temperatures, the body-centered lattice must be replaced by the simpler face-centered γ-Fe. At still higher temperatures, alloying elements, such as Co, Ni, Cr, and Mo must be used. Alloys in which diffusion and volume reactions occur at a slow rate resulting in slight structural changes are apt to be more useful for heat resisting applications. Differences in rate process influence the properties quite strongly; e.g., in carbon steels the rate of grain growth is 10^9 times higher than in the Cr-Ni-W steels. (TTT)

26591 THE INFLUENCE OF ALLOYING ELEMENTS ON THE PHASE COMPOSITION OF CAST AUSTENITIC STEELS. N. Ya. Karasik and N. E. Shlepyanova (Polzunov Central Steam Turbine Inst., [USSR]). Metalloved. i Termicheskaya Obrabotka Metal., No. 2, 28-30(Feb. 1961). (In Russian)

Four identical steel samples were alloyed with W, Mo, and with W + Mo in various proportions. It was found that introduction of either of these alloying additions into the system results in the formation of a carbide of the type of $Me_{23}C_6$. Using a W/Mo ratio of 3:1, in addition to the above carbide, the Laves phase is also obtained after aging at 750 to 800°C and an extended heat treatment. With a W/Mo ratio of 1:1, the Laves phase is formed after aging the alloy for 100 hours at 650°C together with a face-centered cubic interstitial structure. Any Nb present in the steel forms primarily the carbide NbC. (TTT)

26592 THE STRUCTURE AND THE MECHANICAL PROPERTIES OF HIGH-ALLOY TITANIUM ALLOYS. L. S. Golubeva and R. P. Shchegoleva (Central Scientific Research Inst. of Ferrous Metals, USSR). Metalloved. i Termicheskaya Obrabotka Metal., No. 4, 28-30(Apr. 1961). (In Russian)

The effect of heat treatment on the mechanical properties of Ti alloys used for the manufacture of forgings and hot-rolled pipes, and containing Fe, Mn, Cr, and Al was investigated. Depending on the type of heat treatment used, these alloys may possess high strength, especially after age hardening. After forging and rolling, a $\beta + \alpha + \omega$ structure is obtained; the concentration of the ω phase is so low that it cannot be always shown by x-ray diffraction. Under the conditions used, eutectic transformation and $\beta + \omega$ phases are observed. After soaking for 100 hours at temperatures of 400 to 500 and 600°C the system became embrittled; the Al-containing alloy showed a marked tendency toward embrittlement by eutectic transformations while Mn exerted an inhibiting effect. Upon quenching with water, the α phase which has low hardness, is formed; after heating for 15 to 20 hours the hardness increases, passing through a maximum. By age hardening at 400 and 550°C, the maximum hardness is reached with 15 to 30 minutes. This is due to the fact that at low temperatures ω phase precipitates out, while at 500°C this is followed by the precipitation of the α phase, resulting in the reduction of hardness. (TTT)

26593 MECHANICAL AND ENGINEERING PROPERTIES OF TERNARY Ti ALLOYS. L. P. Luzhnikov and V. M. Novikova. Metalloved. i Termicheskaya Obrabotka Metal., No. 4, 31-5(Apr. 1961). (In Russian)

The yield strength, plasticity, weldability and the microstructure of ternary Ti alloys containing Sn, Zr, Cr, V, Mo, or Mn with 94% Ti and up to 6% Sn and up to 6% of one of the above-mentioned β-stabilizers have been investigated, comparing the results with previous data on similar Ti–Al base alloys. It was found that the replacement of Al by Sn as the main alloying element does not present any advantage for the manufacture of sheet metal which must possess high heat resistance and plasticity. Simultaneous alloying of Ti with Al + Zr or Sn + Zr yields alloys with satisfactory mechanical properties. The change of the physical properties of Ti–Sn alloys containing a β-stabilizer follows the pattern observed in similar alloys of the Ti–Al system. (TTT)

26594 RELAXATION PHENOMENA IN TEMPERED STEELS. S. S. Shurakov. Metalloved. i Termicheskaya Obrabotka Metal., No. 4, 36-9(Apr. 1961). (In Russian)

The theory of ductile and quasi-ductile states of tempered steel grain boundaries makes it possible to explain the time dependence of the strength at room temperature and relaxation phenomena of the metal. This ductile state is noticeable not only under conditions leading to fracture but also at stresses below the value of the yield strength. The experiments undertaken to verify this theory by determining the tensile and torsional strength showed that after relaxation the resistance of the steel against deformation increases, as was expected from the theory. The different behavior of the boundary at low stresses results in different values of the strength and plasticity at the time of fracture. The sudden relaxation effect which can be estimated from the strength and plasticity changes is also noted in alloyed ferrites which are not subject to phase transformations at room temperature. The energy of activation of the ferrite and the steels studied was identical. (TTT)

26595 THE THERMOMECHANICAL TREATMENT OF STEEL RESULTING IN HIGH STRENGTH. Ya. M. Potak, Yu. F. Orzhekhovskii, L. M. Pevzner, I. N. Roshchina, and V. N. Ermakov. Metalloved. i Termicheskaya Obrabotka Metal., No. 5, 2-9(May 1961). (In Russian)

Although the resistance of steel against plastic deformation can be greatly increased by alloying and heat treatment, an increase of the tensile strength of tempered steel beyond 220-230 kg/mm^2 is not feasible because of the high C concentration upon aging or because the yield stress approaches too closely the fracture point. However, thermomechanical treatment involving the cold working of the metal in the austenitic state followed by tempering below the recrystallization temperature makes it possible for structural steels with a broad austenitic range to reach a strength of 280-300 kg/mm^2. Increasing the C content up to about 0.5%, the strength after the treatment (at the 90% deformation level) increases but upon further increase of the C content, it decreases because of semibrittle and brittle fracture. The best ratio of strength and plasticity after treatment is obtained by annealing at 100°C; further increase of the temperature results in the lowering of these properties. As a result of the treatment, the martensitic phase is broken up under reduction of the coherent disperse phase region which is one of the chief factors of the resistance against deformation and fracture. (TTT)

26596 FLUCTUATING FORMATION OF GRAPHITIZATION CENTERS IN CAST IRON AND STEEL. A. A. Zhukov (Bauman Inst., [USSR]). Metalloved. i Termicheskaya Obrabotka Metal., No. 5, 22-5(May 1961). (In Russian)

The impossibility of the formation of graphitization centers within the austenitic phase by the annealing of forged iron was pointed out repeatedly. In order to demonstrate the impossibility of the fluctuating formation of graphite nuclei in macroscopically homogeneous austenite, the probability of increasing the number of C atoms from 2 to 456 in space unit of 288 Å^3, the critical size of the nucleus, was calculated, and was found to be 2.54×10^{-23} while the number of fluctuations of critical value in 1 cm^3 was found to be 0.09 and the volume for a single nucleus 11 cm^3. These values are too unfavorable to allow the graphitization process. The effect of alloying additions, such as Si and Cr, is too small to be noticeable. (TTT)

26597 THE EFFECT OF NICKEL, COPPER, MOLYBDENUM, AND BORON ON THE HARDENABILITY OF HIGH-STRENGTH CAST IRON WITH SPHERICAL GRAPHITE. M. V. Boloshchenko (Inst. of Casting, Academy of Sciences, USSR). Metalloved. i Termicheskaya Obrabotka Metal., No. 5, 30-2(May 1961). (In Russian)

Unalloyed cast iron can be more easily hardened with spherical graphite than gray iron and many steels because of the solubility of Mg in the γ-phase, thus increasing the strength of the metal. In order to improve the physical and mechanical properties of castings, the effect of the various alloying additions was studied. It was found that by tempering from 850°C, B does not affect the hardenability noticeably while Mo increased it considerably. Upon tempering from 900°C, the cast iron alloyed with Cu, Ni, Mo, or B exhibited better hardenability than the unalloyed metal. In case of quenching from still higher temperatures, nickel had the strongest influence on hardenability. (TTT)

26598 INTRODUCING BORON SILICIDE. E. Colton (Allis Chalmers Mfg. Co., Milwaukee). Nuclear Eng., 6: 324-5(Aug. 1961).

The preparation and properties of hexaboron silicide are given along with a review of the physical properties of some common high-boron borides. With the exception of the boron silicides, all boron-based solids undergo severe corrosion in air at 800°C and above, forming among other products volatile boric oxide. Boron silicide powder can be handled by the usual metallurgical techniques and sintered compacts are formed by oxide bonding or self-bonding. Oxide-bonded boron silicide has excellent thermal shock resistance and self-bonded material has a density of 2.2 g/cm^3. (N.W.R.)

26599 CERAMICS—THERMAL STRESS RESISTANCE. J. L. Evans. Nuclear Eng., 6: 339-43(Aug. 1961).

Thermal stress resistance theory and data for ceramics used in reactors are presented. There is also a differentiation of transient thermal stresses and steady stresses. In the theoretical treatment, it is assumed that the material is elastic, homogeneous, and isotropic, that fracture occurs when the stress reaches a critical value, and that the mechanical and physical properties are essentially constant over the temperature range considered. The effects of radiation on the ceramic material are also discussed. (N.W.R.)

26600 INVESTIGATION OF THE ANNEALING OF NICKEL DEFORMED BY COMPRESSION BY X-RAY AND STORED ENERGY MEASUREMENTS. D. Michell and E. Lovegrove (Univ. of Melbourne). Phil. Mag.(8) 5: 499-518(May 1960).

X-ray-diffraction patterns from bulk specimens of nickel deformed by compression are measured with a Geiger-counter spectrometer. A composite specimen is used to overcome the effects of preferred orientations. The results indicate that during the annealing there is no change in the background intensity. No evidence is found for stacking faults or changes in lattice parameter. The integrated intensities of all lines remain constant up to a temperature of annealing of about 480°C. A large decrease (30 to 75%) in the integrated intensity of all lines occurs on annealing to 600°C and this is attributed to extinction; an estimate of 2 to 4 μ is obtained for the size of the regions required to produce this effect. The diffraction profiles are analysed by a number of methods. The broadening produced by the particle size effect is small. The stored energies derived from the various methods of analysis range from 0.04 to 2.4 cal/g. Best agreement is obtained between values of stored energy measured using a calorimetric method (0.28 cal/g) and those derived from x-ray measurements if it is assumed that the distribution of strain is Gaussian. (auth)

26601 COMPUTING METHODS AND THE PHASE PROBLEM IN X-RAY CRYSTAL ANALYSIS. Report of a Conference Held at Glasgow, August, 1960. Ray Pepinsky, J. M. Robertson, and J. C. Speakman, eds. International Tracts in Computer Science and Technology and Their Application. Volume 4. New York, Pergamon Press, 1961. 333p. $9.00.

Twenty-nine papers are presented on the phase problem and electronic digital computing methods of x-ray crystal analysis. The phase problem arises because, while it is possible to ascertain the amplitudes of the diffracted waves by measurement of intensities, there is no direct way by which their relative phase relationships can be measured. Recent work on this aspect is summarized. Programming electronic digital computers to this task, and devising better and faster techniques are discussed. (N.W.R.)

26602 URANIUM DIOXIDE: PROPERTIES AND NUCLEAR APPLICATIONS. J. Belle, ed. (Division of Reactor Development, AEC). 1961. 739p. $2.50(GPO).

Information on the properties, technology, and irradiation behavior of UO_2 is assembled and reviewed. The application of UO_2 to nuclear power reactors is discussed. The factors that affect preparation and characterization of UO_2 as a powder and influence its subsequent fabrication into fuel fuel elements are outlined. The physical properties of UO_2 and the detailed phase relationships in the uranium—oxygen

system are presented along with information regarding binary oxide systems. Solid state reactions and the oxidation and corrosion behavior of UO_2 are reviewed. The irradiation behavior of UO_2 and its performance as a fuel material are discussed. (M.C.G.)

26603 PLUTONIUM–CERIUM–COBALT, PLUTONIUM–CERIUM–NICKEL AND PLUTONIUM–CERIUM–NICKEL–COBALT ALLOYS. (to U. S. Atomic Energy Commission). British Patent 874,854. Aug. 10, 1961.

Several low-melting-point, diluted Pu alloys for possible reactor use are described. The alloys are Pu–Ce to which Co and/or Ni are added. A method for their preparation is described. Ta and W are suitable container materials for these alloys. (D.L.C.)

26604 IMPROVED ALLOYS CONTAINING NOBLE METALS. (to U. S. Atomic Energy Commission). French Patent 1,208,840. Feb. 25, 1960.

An alloy is described that can be used for making control rods of a nuclear reactor. It comprises suitably 0.5% to 1.5% of a noble metal such as platinum, ruthenium, rhodium, osmium or palladium, 0 to 10% of cadmium, 2 to 10% of indium, the rest silver. The constituents are melted together preferably in a graphite crucible by induction heating. To avoid oxidation of the melted alloy the surface is protected by a layer of coke. (NPO)

26605 MAGNESIUM ALLOYS FOR THE MANUFACTURE OF FUEL ELEMENT CANS. (to British Thomson-Houston Co., Ltd.). French Patent 1,222,482. Jan. 25, 1960.

A creep resistant Mg alloy for fuel element cans containing 0.3 to 0.8% Zr, 0.05 to 0.30% Mn and, optionally, 0.3 to 2% Zn is offered. (NPO)

26606 TERNARY URANIUM ALLOY. (to U. S. Atomic Energy Commission). French Patent 1,226,385. Feb. 22, 1960.

A corrosion-resistant fuel alloy consisting of 2.5 to 6 wt.% Ti, 1 to 2 wt.% Nb, remainder U is given. 3% Ti and 1.5% Nb are preferred. (NPO)

26607 NICKEL ALLOY. (to U. S. Atomic Energy Commission). French Patent 1,229,765. Mar. 28, 1960.

A nickel alloy for nuclear applications is described. It contains preferably 16 to 18% Mo, 0.02 to 0.5% C, 6 to 8% Cr and 0 to 4% Nb. The method of its preparation is described. The alloy is highly resistant toward oxidation and corrosion by fused salts and does not tend to become brittle in reactor service. (NPO)

26608 PLUTONIUM ALLOY. (to U. S. Atomic Energy Commission). French Patent 1,233,199. May 2, 1960.

A liquid metal fuel is described consisting of a Pu alloy with the following composition: 10 to 25 at.% Ni or Co and 90 to 75 at.% Pu + Ce, the quantity of Pu not being in excess of 86 at.%. (NPO)

26609 URANIUM ALLOY. (to United Kingdom Atomic Energy Authority). French Patent 1,239,221. July 11, 1960.

Creep and radiation resistant uranium fuel alloys, containing 10 to 27 wt.% Mo and 2 to 6 wt.% Ta and/or W, are described. (NPO)

Radiation Effects

26610 (BMI-1529) RADIATION STABILITY OF SPHERICAL AND HYDROTHERMAL UO_2 DISPERSED IN TYPE 318 STAINLESS. David G. Freas, James H. Saling, John E. Gates, Donald L. Keller, and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). July 14, 1961. Contract W-7405-eng-92. 25p.

An irradiation study of dispersions of fully enriched 30 wt % MCW spherical UO_2 and 30 wt % ORNL hydrothermal UO_2 in Type 318 stainless steel was performed to compare the irradiation stability of the two dispersions. Eight specimens were irradiated in the MTR in two capsules equipped with thermocouples. Temperature measurements and isotopic-burn-up analyses indicated that the specimens were irradiated at center-line temperatures ranging from about 800 to 1600°F with burn-ups ranging from 11.8 to 15.1 at % of the uranium-235. The post-irradiation examination of the specimens from these capsules included fission-gas analyses, dimensional and density determinations, isotopic-burn-up analyses, quantitative metallographic examinations, and a study of swelling in the indivídual fuel particles. Only minor changes in the dimensions and appearance of both types of dispersions were observed as a result of irradiation under the experimental conditions. Measurements of UO_2 particle sizes revealed that gross swelling did not occur in either type of UO_2 dispersions during irradiation. (auth)

26611 (HW-62453) CONTROLLED TEMPERATURE IRRADIATION OF GRAPHITE. Interim Report No. 4, PT-IP-22A. K. Koyama (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 21, 1959. 12p.

The experimental details and evaluation of the equipment necessary for controlled temperature irradiations are reported. Temperatures at which the samples were irradiated are plotted. There were many unexplained electrical disturbances and heater failures. (P.C.H.)

26612 (HW-68494) THE EFFECT OF IRRADIATION ON SILICONIZED-SILICON CARBIDE COATINGS FOR GRAPHITE. J. L. Jackson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1961. Contract AT(45-1)-1350. 16p.

The results of an investigation into the effect of irradiation on the quality and integrity of several commercial siliconized-silicon carbide (Si–SiC) coatings for graphite are summarized. Si–SiC–coated graphites were oxidation-tested at 1000°C in air both before and after irradiation. Data show that base graphites for coating must be fairly isotropic and must be stable toward high temperature radiation damage if the coating is to survive in-reactor conditions. (auth)

26613 (NP-9572) POLYURETHANE GAMMA RADIATION RESISTANCE. Preliminary Report, May 15, 1958–December 1, 1958. C. S. Schollenberger, L. G. Pappas, J. C. Park, V. V. Vickeroy, and E. B. Newton (Goodrich (B. F.) Co. Research Center, Brecksville, Ohio). Dec. 1, 1958. 9p.

Samples of two high-strength thermoplastic polyurethane Estane elastomers and one high-strength thermoset Estane elastomer were prepared and about a dozen different physical properties as well as infrared and ultraviolet absorption spectra determined for each composition. Radiation doses of 6 to 26 × 10^6 roentgens were applied to Polyurethane VC samples in air and in nitrogen environments and in a 50 micron vacuum. Infrared and ultraviolet absorption spectra changes in the polymer attending the exposure are under study, evolved gases are identified in the mass spectrometer, sol-gel determinations to establish crosslinking/chain scission ratios are made, and macromolecular changes in the exposed polymer are estimated using light scattering techniques, the constant load rheometer, and the dynamic extrusion rheometer, and from intrinsic viscosity data. (auth)

26614 (NP-10506) MONTHLY ACCESSION LIST NO. 48, ON [RADIATION EFFECTS], JUNE 1–June 30, 1961. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). July 15, 1961. 19p.

References (52) and abstracts on electronics, polymeric materials, metals and ceramics, dosimetry, and space environmental effects from U. S. and foreign journals and reports published from January, 1960 to June, 1961, along with a few papers presented at meetings during 1959 and 1960 are given. A list of REIC publications issued is also included. (P.C.H.)

26615 (REIC-Memo-21) SPACE RADIATION AND ITS EFFECTS ON MATERIALS. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). June 30, 1961. Contract AF33(616)-7375. 40p.

Recent literature concerning the space-radiation environment is reviewed. Data on space radiation from an engineering standpoint and its effects on materials and devices are discussed. It was concluded that space radiations do not present design problems in the case of engineering materials unless these materials undergo sustained exposure on the order of several years. However, for radiation-sensitive materials, damages from space radiation will be a serious problem even for short exposures when changes in the characteristics can affect performance. The Van Allen Radiation Belts, cosmic radiation, interactions of space radiations with matter, and radiation effects are discussed. (M.C.G.)

26616 (TID-13122) INVESTIGATIONS OF RADIATION EFFECTS IN METAL OXIDES AND AZIDES BY ELECTRON SPIN RESONANCE. Progress Report, March 16, 1960 to January 31, 1961. Otis R. Gilliam (Connecticut. Univ., Storrs). Jan. 31, 1961. Contract AT(30-1)-2047. 19p.

New electron spin resonances were detected in $\alpha - Al_2O_3$ following gamma irradiations, reactor irradiations, or gamma irradiations after higher temperature reactor irradiations. Symmetry properties, annealing behaviors, line widths, g-values, and discussion of these effects are presented. Spin resonances were obtained by gamma irradiation of TiO_2 at 77°K; similar resonances could be obtained by uv irradiation. Characteristics of the radiation-induced centers are described. Fe^{3+} and Cr^{3+} resonances, and unknown impurity lines in the TiO_2, diminished as new valence states were created. Further investigations in gamma irradiated potassium azide are briefly described. Three defects are detected following irradiation one showing probable hyperfine interaction with two nitrogen nuclei and the other hyperfine structure due to one nitrogen nucleus. The other defect was the N_4^- molecule-ion reported previously. Quenching of flame-softened fused silica in water induced a weak spin resonance, and it also gave an enhancement of the coinciding electron spin resonance absorption developed by subsequent uv irradiation. Gamma irradiation yielded two lines separated by 75 gauss, a partial interpretation of which is given. Microwave techniques employed for these investigations are described. (auth)

26617 THE CREATION OF MULTIPLE THERMAL POINTS BY RADIATION. Aretin Corciovei and Dan Grecu (Inst. for Atomic Physics, Bucharest). Compt. rend., 252: 3964-6(June 19, 1961). (In French)

The distribution of simple thermal points (the small region around a final displaced atom heated to a temperature above the fusion temperature of the metal) is determined by the distribution of the final displaced atom. This distribution depends on the mean free path λ of the displaced atoms. The λ was calculated by the pulse method. For Cu the actual values are less than those predicted. This confirms the possibility of the appearance of multiple thermal points in spherical layers. An equation was set up for the approximate radius of the layer. The diffusion of heat from the spherical layer of interstitial atoms is studied. (J.S.R.)

26618 ELECTRONIC PARTS IN A HYPERNUCLEAR ENVIRONMENT. Leonard B. Gardner and Alvin B. Kaufmann (Litton Systems, Inc. Woodland Hills, Calif.). IRE Trans. Nuclear Sci., NS-8: No. 3, 35-44(July 1961).

Tests were conducted to find electronic parts that function properly during and after exposure to a steady-state environment of mixed gamma rays and neutrons such that in 100 hours, 10^{11} ergs/gm(c) and 2.5×10^{15} n/cm^2 ($E_n > 2.9$ Mev) would be accumulated. The tests were all conducted with the parts operating. Experimental results are presented and discussed, and specific manufacture recommendations are made. (L.N.N.)

26619 IRRADIATION-INDUCED PHASE-TRANSFORMATIONS IN METALS AND ALLOYS. R. Smith (Australian Atomic Energy Commission, Lucas Leights, New South, Wales). J. Australian Inst. Metals, 5: 163-72(Aug. 1960).

The effects of neutron radiation on order-disorder, precipitation, phase-reversal, and martensitic reactions are discussed in relation to theories of radiation damage. (auth)

26620 ELECTRON SPIN RESONANCE OF AN IRRADIATED SINGLE CRYSTAL OF UREA OXALATE. D. V. G. L. Narasimha Rao and Walter Gordy (Duke Univ., Durham, N. C.). J. Chem. Phys., 34: 362-8 (July 1961).

Free radicals produced in a single crystal of urea oxalate by gamma irradiation were investigated with the method of electron spin resonance. Only one species of free radical was observed at room temperature. Analysis of the resonance leads to the conclusion that the free radical has the form RCHOH with the electron spin density concentrated mostly on the CH carbon. The radical was found to be very stable: Its ESR pattern was observed, essentially undiminished, for more than a year after the irradiation. The g factor was found to be only slightly anisotropic, with principal values: $g_u = 2.0024$, $g_v = 2.0048$, and $g_w = 2.0047$. Couplings with two H nuclei are believed to be those indicated by $H^{(1)}$ and $H^{(2)}$, with principal elements of coupling in gauss, of 15.7, 26.5, and 8.1 for $H^{(1)}$, and of 6.2, −0.3, and 8.3 for $H^{(2)}$. With irradiation and observation at 77°K, a different free radical was observed, one with hyperfine structure from only one H, similar to $H^{(2)}$. (auth)

26621 THE RELATIONSHIP BETWEEN IRRADIATION GROWTH AND OTHER PROPERTIES OF ALPHA-URANIUM. J. J. Stobo and B. Pawelski (C. A. Parsons and Co., Ltd., Newcastle-upon-Tyne, Eng.). J. Nuclear Materials, 4: 109(May-June 1961). (In English)

Single crystal values of expansion coefficient and resistivity are given. High resistivity in a particular direction indicates an excess of [100] directions over random while a low expansion coefficient indicates an excess of [010] directions. When the two measurements are made in the same direction on the same specimen, an estimate of the tendency to irradiation growth can be obtained. (P.C.H.)

26622 ABSORPTION SPECTRUM OF γ-IRRADIATED LEAD SILICATE GLASS. R. S. Barker, T. K. Harrison, D. A. Richardson, and R. Rimmer (Pilkington Brothers, Ltd., Lathom, Ormskirk, Eng.). Nature, 191: 374(July 22, 1961).

The absorption spectrum of γ-irradiated lead silicate glass showed three absorption bands at 1.7, 2.3, and 3.3 ev respectively. The separation of the spectral curve into these bands was obtained by assuming that the peak at

3.3 ev was uninfluenced by the presence of any other bands. The points in the vicinity of this peak were used to estimate the first Gaussian and the other bands were obtained by successive subtraction. Further work employing different methods was done in order to confirm this separation, making only the assumption that the spectral absorption curve consists of a small number of Gaussian-shaped components. This problem is well suited to solution by means of an electronic digital computer and a programme was written using the equation $y = \Sigma A_i \exp B_i (x - c_i)^2$ where A_i corresponds to the peak height of the absorption band at a wave-length of $1/c_i$, B_i is a function of the half-peak width of this band, and x is the reciprocal of the wave-length at the point considered. By a process of successive iteration it was found that the full spectral absorption curve in the region 350 to 1,000 mμ could be accurately represented as the sum of two Gaussian absorption bands with maxima at 2.54 and 3.36 ev. Typical results are presented. No evidence was found for an absorption band at 1.7 ev, but considerable interaction between the two bands at their peak wave-lengths was demonstrated. The measured values and the sum of the two Gaussian bands obtained by computation are shown. (auth)

26623 SLOW DECOMPOSITION OF EXPLOSIVE CRYSTALS AND THEIR DAMAGE BY FISSION FRAGMENTS. F. P. Bowden and H. M. Montagu-Pollock (Cavendish Lab., Cambridge, Eng.). Nature, 191: 556-9(Aug. 5, 1961).

Direct transmission electron microscopy was used to study both thermal and fission fragment decomposition of silver cyanamide (Ag_2CN_2) crystal. It was found to be stable in electron beams of moderate intensity, and the crystals were grown thin enough (about 100 molecules thick) to be observed in transmission. The main products of decomposition at low temperatures are silver, carbon, and gaseous nitrogen. Nucleation at the interface between parent crystal and solid decomposition product was observed only in the special case involving the initiation of holes of crystallographic shape. The decomposition is shown to take place everywhere on the crystal surface; and there is a suggestion that surface steps have some influence on the decomposition. (P.C.H.)

26624 POLARIZATION INDUCED BY RADIATION IN 'PERSPEX.' V. J. Vanhuyse, G. J. Vanpraet, and J. F. Van Landuyt (Rijksuniversiteit, Ghent). Nature, 191: 595-6 (Aug. 5, 1961).

Several identical polished Perspex blocks were bombarded with 1.2×10^{14} electrons of 2.5 Mev. The blocks were examined with a polariscope with convergent light, the specimen being placed so that one of the largest faces was viewed. Before irradiation, no interference pattern was observed. Immediately after irradiation, an interference pattern was seen that behaved as if the Perspex block was a uniaxial double refractive crystal, the optical axis coinciding with the direction of the beam. A circular isochromate and the dark cross, each line of which corresponds to the direction of the polarizer and analyzer was observed. After 2 hrs it disappeared completely. It seems evident that something like the Kerr electro-optic effect occurs. (P.C.H.)

26625 INTERSTITIAL DEFECTS IN LiH AND NaCl IRRADIATED AT LOW TEMPERATURES. F. E. Pretzel and R. L. Petty (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 123: 464-5(July 15, 1961).

Expansions of the lattice parameters of both LiH and NaCl exposed to β radiation at 77 and 245°K have been observed using a vacuum x-ray diffractometer stage operated at 77°K. The source of the β radiation was 5.56% LiT contained in a LiH crystal which was ground and mixed with NaCl in the samples. The LiH lattice parameter increased 0.0020 ± 0.0007 A in three samples. This result is consistent with density measurements and with the formation of interstitial He^3 atoms in the LiH lattice. The NaCl lattice parameter increased 0.0061 ± 0.0009 A even though the average β dose for the NaCl was less than 1% of that in the Li(H,T) and tritium β particles with maximum energy cannot produce direct displacements in NaCl. A mechanism is proposed for the production of Cl^- interstitials and vacancies (Frenkel defects) in NaCl which is similar to one proposed by Klick for the production of F and H centers. This mechanism is related to observations of the production of α centers in alkali halides irradiated at low temperatures. (auth)

26626 RECOVERY OF ELECTRON RADIATION DAMAGE IN n-TYPE InSb. F. H. Eisen (Atomics International, Canoga Park, Calif.). Phys. Rev., 123: 736-44(Aug. 1, 1961).

The production and recovery of electron radiation damage in n-type InSb has been studied by means of Hall-coefficient and electrical-conductivity measurements. Irradiations were performed mainly at 80°K, since no recovery was observed between 4° and 80°K. The damage recovered in five well-defined stages with the recovery nearly complete at 320°K. Isochronal and isothermal recovery was monitored in each of the stages, allowing a determination of the activation energies for recovery and a study of the recovery kinetics. None of the recovery kinetics fit any simple models. There is evidence that the two lowest-temperature recovery stages involve the annihilation of close interstitial-vacancy pairs and that interactions of primary defects with impurities do not occur. However, the first-order kinetics expected for close-pair recovery is not explicitly observed. A possible explanation for the observed kinetics, involving the independent annihilation of two types of close-pair configurations in the same stage with an electrostatic interaction between the interstitial and vacancy, is proposed. (auth)

26627 THERMAL IMPACT—THE MECHANICAL RESPONSE OF SOLIDS TO EXTREME ELECTROMAGNETIC RADIATION. J. E. Michaels (General Electric Co., Philadelphia). Planetary Space Sci., 7: 427-33(July 1961).

The phenomenon of thermally induced stress waves resulting from the deposition by radiation of intense electromagnetic energy into the surface of a solid is described. Both theoretical and experimental aspects are treated. The derivation and general solution for the case of a semi-infinite bar are given. A recent experiment is described which for the first time demonstrated and verified the thermal impact phenomenon. The design and development of an optimized experimental facility by which the phenomenon can be studied in the laboratory is discussed. (auth)

PHYSICS

General and Miscellaneous

26628 (AERE-M-893) MERCURY PROGRAMMES FOR THE REDUCTION OF OBSERVATIONS ON ALLOY FOILS TO SATURATION ACTIVITY. C. J. Kenward (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1961. 13p.

Two Mercury autocode programs are described which reduce counting observations on two-component foils to estimates of the saturation activities of the two components. The programs apply calibration factors and corrections for counter efficiency, background, dead-time, finite irradiation, and decay, and reject observations which lie more than three standard deviations from the mean. (auth)

26629 (AFBSD-TR-61-2) RADIATION FROM HOT NITROGEN. Research Report No. 102. R. A. Allen, J. C. Camm, and J. C. Keck (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Apr. 1961. Contracts AF04 (647)-278 and DA19-020-ORD-4862. 15p.

The equilibrium radiation emitted by shock heated nitrogen was studied at 3300 to 7100 A at an equilibrium temperature of 6000 A to 7000°K and densities .01 to .20 times atmospheric. Identification of the various radiating band systems was accomplished by spectroscopic techniques. The absolute intensity versus wavelength profile at thermodynamic equilibrium was obtained using photometric methods. By comparing this profile with theoretical predictions, the electronic f-number for the $N_2^+(1-)$ system was found to be .09 ± .05. CN and O_2 contamination effects were also investigated. By studying the density dependence of the radiation, the collisional deactivation cross section for this band was found to be greater than 10^{-15} cm^2. (auth)

26630 (AFOSR-1165) THE CONFIGURATION AVERAGE OF THE GROUND STATE ENERGY OF AN ISOTOPICALLY DISORDERED LATTICE, INCLUDING THE CONTRIBUTION FROM CUBIC AND QUARTIC ANHARMONIC TERMS IN THE POTENTIAL ENERGY OF THE LATTICE. APPLICATION TO A LINEAR CHAIN AND THE PARTICULAR CASE OF A HYDROGEN–DEUTERIUM MIXTURE. Technical Report 219. Rosemary A. Coldwell-Horsfall and Alexei A. Maradudin (Maryland. Univ., College Park). July 1961. Contract AF49(638)-399. 51p.

Deviations from the laws of perfect solutions were observed in mixtures of light isotopes such as H_2-D_2 and He^3-He^4 mixtures. The free energy of the disordered state appeared to be always greater than that of the pure isotopes so that phase separation occurred below a certain critical temperature. An expression was obtained for the configuration average of the ground state energy of an isotopically disordered lattice, taking into account the cubic and quartic anharmonic terms in the expansion of the potential energy of the lattice in powers of the nuclear displacements. This result was applied to the case of a linear chain and the difference between the ground state energy of a disordered linear chain and that of the separated components was calculated for the particular case of an equimolecular mixture of hydrogen and deuterium. The calculation was carried out to second order in the parameter μ which represents the deviation of the isotopic masses from the mean mass of the lattice. This enabled a comparison to be made of this result with that of Prigogine et al. It was found that the difference between the ground state energy of the disordered state and that of the separated phases has the value 10.38 cals/mole. The anharmonic contribution to the ground state energy caused this difference to be less than in the harmonic approximation. (auth)

26631 (ANL-6376) PHYSICS DIVISION SUMMARY REPORT, JUNE 1961. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 63p.

Deformation of Rotor III is reported at 20,240 rpm. A shrinking process restored it to the original characteristics. Installation and operation of the 4.5-Mev Van de Graaff generator is reported. The lifetimes of the low-lying excited states in V^{51}, Ni^{61}, Ga^{69}, As^{75}, Br^{79}, Rb^{85}, and Sb^{123} were measured. A theory for nuclear resonance absorption of gamma radiation was extended to account for the effects of light modulation which was recently observed. Measurements of the total cross sections of N and O at 1 to 450 kev are reported. Theoretical fragmentation yields for acetylene, ethylene, and benzene were determined. Experimental measurements of rf fields were interpreted to indicate that a bounded high-frequency low-pressure laboratory plasma is space-charge polarizable. (J.R.D.)

26632 (CEA-1851) CONSIDERATIONS SUR LA CREATION DE CHAMPS MAGNETIQUES ELEVES. REFROIDISSEMENT DES BOBINES. (Notes on the Creation of High Magnetic Fields. Cooling of the Coils). Georges Armand (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 54p.

When the temperature of a conductor is lowered, its resistance decreases appreciably. This fact can be used in the production of high magnetic fields. The problem of the evacuation of heat is examined, and the various fluids which can be used are compared from the viewpoint of the maximum fields attainable for a given coil. These fluids are water (nucleate boiling), liquid nitrogen, liquid hydrogen, and helium at 10 and 20°K. A method for calculating the quantities of heat evacuated by a fluid is established using general equations for fluid flow with heat exchange. (auth)

26633 (GAMD-2033) HEAT CONDUCTIVITY OF HELIUM AND CARBON DIOXIDE. Final Report. A. C. McClure (General Dynamics Corp. Electric Boat Div., Groton, Conn.). Aug. 11, 1959. Contract AT(04-3)-187. 23p. (MGCR-PR50-404)

A discussion of developmental work is presented. Included is information on design of the thermostat unit, high pressure equipment, thermoconductivity cell, and instruments for pressure and temperature recording. Experimental procedures are outlined and results are tabulated. (J.R.D.)

26634 (JINR-P-114) O NOVOM METODE V TEORII SVERKHPROVODIMOSTI. (On New Method in the Theory of Superconductivity). V. V. Tolmachev and S. V. Tyablikov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1957. 13p.

The equivalence of Bardeen and Frëhlich Hamiltonians is determined in adiabatic approximation, and the ground state energy and elementary excitations are calculated by canonical transformation methods. (tr-auth)

26635 (JINR-P-297) FOTOELEKTRITY I PERSPEKTIVY IKH PRIMENENIYA V YADERNOI FIZIKE. (Photoelectrets and their Future Applications in Nuclear Physics). B. M. Golovin, I. S. Zheludev, N. I. Kashukeev, and V. M.

Fridkin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 16p.

A review is given of the principle characteristics of photoelectrets polarized by irradiation. Photoelectret applications in electrophotography and future applications in nuclear physics and allied sciences are discussed. (tr-auth)

26636 (JPL-TR-32-118) OPTIMUM THRUST PROGRAMS FOR POWER-LIMITED PROPULSION SYSTEMS. William G. Melbourne and Carl G. Sauer, Jr. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). June 15, 1961. Contract NASw-6. 45p.

The optimum thrust equations for two thrust programs are presented. In the first program, the thrust vector is unconstrained; in the second program, the thrust magnitude is constrained to be a constant or zero along the trajectory. These programs are obtained by a consideration of a more general thrust program containing both modes of thrust operation. The optimization process is carried out for three separate criteria: maximum final vehicle mass for a given powerplant, minimum flight time, and a minimum value of the quantity $\int_0^{t_1} a^2\,dt$, where t_1 is flight time and a is thrust acceleration. This integral is a measure of the propellant requirement for a power-limited vehicle. These two sets of equations were applied to an inverse square central force field model. The problem of terminal conditions is discussed and the transversality relations for both flyby and rendezvous planetary missions are developed in three dimensions. For purposes of comparison, the analytic solutions for these thrust programs in a one-dimensional field-free model are presented. An iterative routine to solve the two-point boundary value problem was coupled with these equations to obtain numerical solutions for specified end conditions and transversality expressions. A set of two-dimensional trajectories from Earth to Mars is presented using these two thrust programs and the various optimization criteria. A summary of the effects of these two programs on vehicle performance is presented. (auth)

26637 (NP-9538) NRL QUARTERLY ON NUCLEAR SCIENCE AND TECHNOLOGY. Progress Report for the Period July–September 1960. (Naval Research Lab., Washington, D. C.). Oct. 1, 1960. 24p.

Discussions are presented of research carried out in the fields of: Nuclear Physics, on prompt γ rays from He^3 bombardment of O^{16}, mesons-π^0 lifetime, and a photo-proton spectrometer; High-temperature Physics, on a selective signal detector for measuring low-level radioactive airborne contamination, and a computer analysis of Brillouin flow in relativistic beams of moderate current; and Dielectrics, on the CaF_2:Mn thermoluminescence dosimeter, and luminescence phenomena in glass. (B.O.G.)

26638 (NP-9565) RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. Third Quarterly Progress Report, June 16, 1960 through September 15, 1960. R. Novick (Columbia Univ., New York. Columbia Radiation Lab.). Sept. 15, 1960. Contract DA-36-039 SC-78330. 46p. (CU-9-60 SC-78330 Phys.)

Experiments are described which are concerned with the design of masers, and with the application of masers to physical and astronomic problems. A technique for measuring paramagnetic relaxation times, and studies of stressed paramagnetic crystals are discussed. A 21 cm radioastronomy maser system was installed at the Naval Research Laboratory and is in use. The M-bond radio telescope is near completion and will be used to study sextuply ionized N in the sun's atmosphere as well as the O_2 content of the upper earth's atmosphere. A charged particle detector was constructed, which displays glow discharges along the tracks of cosmic ray particles in a microwave cavity. Studies toward operation of an infrared maser are continuing. Various molecular beam experiments, including measurements of the hyperfine structure of Kr^{83}, work on the metastable H atom, determination of the spin of O^{15} and molecular velocity selection are described. An optical double resonance experiment was designed for the determination of the spin of Cd^{109} and other isotopes. An optical crossing point experiment was undertaken and will be applied to Cd and other group II elements. (auth)

26639 (NP-10247) PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961. (India. Dept. of Atomic Energy. Physics Advisory Committee, Bombay). 537p.

Seventy four papers were presented at the symposium. Seventy one of these papers are included in full, and 3 in the form of abstracts in these proceedings. Separate abstracts were prepared for 68 of the papers. Three of the papers were previously abstracted in NSA. (T.F.H.)

26640 (NP-10247(p.1-18)) NEUTRON MATTER. E. E. Salpeter (Cornell Univ., Ithaca, N. Y.). p.1-18 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The conditions are outlined under which matter can exist in the form of lattices of free neutrons. This situation may arise, for instance, in a star whose temperature is less than $10^{9\circ}$K and whose density is greater than about 10^7g/cm^3. The protons in the nuclei are converted into neutrons by inverse β decay, thus causing the nuclei to break up into separate neutrons. The properties of stars composed of neutron matter are discussed. (T.F.H.)

26641 (NP-10247(p.21-9)) COMPARISON OF EXPERIMENTAL AND THEORETICAL VALUES OF NEUTRON CROSS SECTIONS AT 14 MEV. C. S. Khurana and H. S. Hans (Aligarh Muslim Univ., Aligarh, India). p.21-9 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The cross sections for neutron reactions (n,p), (n,α), and (n,2n) at 14 Mev are calculated and observed as a function of the target nucleus mass number. The calculations are made on the basis of the statistical theory of compound nucleus formation, with corrections for direct interaction effects. (T.F.H.)

26642 (NP-10247(p.30-9)) THE ENERGY AND ANGULAR DISTRIBUTIONS OF PROTONS EMITTED FROM Al^{27} DUE TO 14 MEV NEUTRON INTERACTIONS. K. G. Nair, K. N. Iyengar, and R. Ramanna (Tata Inst. of Fundamental Research, Bombay). p.30-9 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The angular and energy distributions of protons from neutron reactions (n,p) and (n,pn) on Al^{27} are studied at 14.2 Mev. It is found that compound nucleus formation is dominant in the backward angles, but the other processes (e.g. direct interactions) are important in the forward direction. (T.F.H.)

26643 (NP-10247(p.40-6)) ENERGY AND ANGULAR DISTRIBUTION OF CHARGED PARTICLES FROM (F^{19}+n) REACTIONS. C. Badrinathan, M. L. Jhingan, and E. Kondaiah (Tata Inst. of Fundamental Research, Bombay). p.40-6 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The energy and angular distributions of products from neutron reactions (n,p), (n,d), (n,t), and (n,α) on F^{19} are studied at 14 Mev. The Q-values of these reactions are given. (T.F.H.)

26644 (NP-10247(p.47-8)) POLARIZATION CORRELATION MEASUREMENTS OF γ-RAYS IN Gd^{154}. C. V. K. Baba and S. K. Bhattacharjee (Tata Inst. of Fundamental Research, Bombay). p.47-8 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The spins and parities of the 1400 and 1723 kev excited states of Gd^{154} are calculated from directional correlation and polarization correlation measurements on their 1277-123 and 725-998 kev γ cascades respectively. It is found that both levels are 2— states. (T.F.H.)

26645 (NP-10247(p.49-54)) DISINTEGRATION OF Rh^{97}. B. Basu and A. P. Patro (Saha Inst. of Nuclear Physics, Calcutta). p.49-54 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27—MARCH 2, 1961.

The half life, positron spectrum, and gamma spectrum of Rh^{97} are found. The half life is found by several methods to be 33 ± 4 min. Two positron groups are found, with end energies of 2.1 ± 0.1 and 1.8 ± 0.1 Mev. (T.F.H.)

26646 (NP-10247(p.55-63)) MEASUREMENT OF RADIATIVE CORRECTION TO SINGLE SCATTERING OF RELATIVISTIC ELECTRONS FROM NUCLEI. M. R. Bhiday (Mahakoshal Mahavidyalaya, Jubbulpore, India). p.55-63 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

Calculated and observed values of radiative corrections to the electron-nucleus elastic interaction cross sections are presented. The radiative correction is in the form of a factor (1-δ) applied to the cross section, in which δ is a function of the scattering angle θ and the energy resolution ΔE of the electron beam. Observed values of δ vary between 4 and 7% for θ = 30, 60, and 90°, with ΔE between 0.5 and 3.0%. The theoretical values of δ in this range are around 6%. (T.F.H.)

26647 (NP-10247(p.64-83)) RESONANCE SCATTERING OF GAMMA RAYS. B. S. Sood (Panjab Univ., Chandigarh, India). p.64-83 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The resonance absorption of gamma radiation (e.g., the absorption in Pb^{208} of the 2.62 Mev γ ray from decay of the 2.62 Mev excited state of Pb^{208}) is studied. Processes that hinder this effect, such as recoil, are described, and mechanisms for enhancing the effect are listed. Absorption may be enhanced by mechanisms that cause overlap between the emission and absorption lines. Such mechanisms include the natural line widths, Doppler broadening effects, and relative source-absorber motion. Resonance scattering theory is discussed, as well as self-absorption phenomena. (T.F.H.)

26648 (NP-10247(p.84-94)) ANGULAR CORRELATION STUDIES OF THE 358 Kev → 81 Kev CASCADE IN Cs^{133}. B. N. Subba Rao (Tata Inst. of Fundamental Research, Bombay). p.84-94 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The 358-81 kev gamma cascade in Cs^{133} is studied. It is proposed that the cascade involves the following transitions between energy levels: 437 kev ($\frac{3}{2}$+) $\xrightarrow{M1}$ 81 kev ($\frac{5}{2}$+) $\xrightarrow{M1+E2}$ 0 kev ($\frac{7}{2}$+), with spins and parities as indicated in parentheses. The 81 kev transition is l-forbidden, so that the conversion coefficients show deviations from their expected values. The total, K, and L + M conversion coefficients are deduced from the observed electron and γ spectra. From the deduced coefficients and the proposed decay scheme, the nuclear-structure parameter is calculated. (T.F.H.)

26649 (NP-10247(p.95-103)) FURTHER STUDIES ON THE DECAY OF Rh^{106}. S. Y. Ambiye and R. P. Sharma (Tata Inst. of Fundamental Research, Bombay). p.95-103 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The β decay of Rh^{106} is studied. By observation of the β, γ, β-γ coincidence, and γ-γ coincidence spectra, a decay scheme for Rh^{106} and an energy level scheme for the daughter Pd^{106} are deduced. (T.F.H.)

26650 (NP-10247(p.109-12)) RECOIL-FREE RESONANCE SCATTERING OF 14.4 KeV GAMMA RAYS IN ^{57}Fe. B. S. Sood (Panjap Univ., Chandigarh, India). p.109-12 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The resonance scattering cross section is found to be 142 ± 30 barn at 120° scattering angle. This cross section value indicates that either the 14.4 kev state is split by the intrinsic nuclear magnetic field, or that both states are split. (T.F.H.)

26651 (NP-10247(p.113-35)) RECENT DEVELOPMENTS IN THE THEORY OF NUCLEAR STRUCTURE. Manoj K. Banerjee (Saha Inst. of Nuclear Physics, Calcutta). p.113-35 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

Two methods applicable to the collective model and the shell model of the nucleus are described. These methods permit extensive energy level calculations to be performed. In the first method, the ground state of the nucleus is described by a Bardeen-Cooper-Schrieffer type function. The excited states are determined by the short range part of the nucleon wave function. In the second method, the long range interaction is emphasized; the effect of the long range interaction on the Hartree field are used to find the energy levels. (T.F.H.)

26652 (NP-10247(p.136-9)) $S^{\frac{1}{2}}$-PARTICLE DOUBLETS IN THE REGION A ≈ 30. S. P. Pandya and S. K. Shah (Physical Research Lab., Ahmedabad, India). p.136-9 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27—MARCH 2, 1961.

The energy levels in Cl^{34}, Cl^{36}, and K^{38} are used, along with the j-j coupling shell model, to determine the exchange parameters in the central two-body interaction. These parameters are used to find the $s_{\frac{1}{2}}$-$d_{\frac{3}{2}}$, $s_{\frac{1}{2}}$-$s_{\frac{1}{2}}$, and $s_{\frac{1}{2}}$-$d_{\frac{5}{2}}$ doublet splittings in the ground states of Al^{28}, P^{30}, and P^{32} respectively. These calculated splittings are compared with the experimental values. (T.F.H.)

26653 (NP-10247(p.140-2)) THE TRITON PROBLEM WITH SEPARABLE POTENTIALS. A. N. Mitra (Delhi. Univ.). p.140-2 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The triton is studied by a three-body approach, using a separable potentials method. The n-p and n-n interactions are assumed to be pure S-waves, thus allowing the three-body problem to be simplified to a two-body problem with local potentials. (T.F.H.)

26654 (NP-10247(p.143-5)) APPROXIMATE ESTIMATE OF ELECTRON SCATTERING CROSS SECTIONS WITH BRUECKNER'S CHARGE DISTRIBUTION. N. V. V. J. Swamy and R. J. Kulkarni (Karnatak Univ., Dharwar, India). p.143-5 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The Brueckner, smoothed Fermi, and harmonic oscillator charge distribution models for Ca^{40} are used, along with the Born approximation, to calculate the differential scattering cross section for electrons on Ca^{40}. The Brueckner distribution disagrees with the experimental data, even for small scattering angles. The other two distributions considered are compatible with the data. (T.F.H.)

26655 (NP-10247(p.146-50)) VARIATION OF 'EQUIVALENT DENSITY' WITH MASS-NUMBER AND ITS CONNECTION WITH THE GAS-MODEL. Rajat K. Bhaduri (Tata Inst. of Fundamental Research, Bombay). p.146-50 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The equivalent density of a nucleus is defined by $3r_0^{-3}/4\pi$, where r_0 is defined by the equation $R = r_0 A^{1/3}$, and R, the nuclear radius, is found from the scattering data, and A is the nuclear mass number. It is shown that a calculation based on the gas model of the nucleus yields densities that are compatible with the experimental data. (T.F.H.)

26656 (NP-10247(p.151-4)) AN APPROXIMATE METHOD IN THE THEORY OF FINITE NUCLEI. Kailash Kumar and Rajat K. Bhaduri (Tata Inst. of Fundamental Research, Bombay). p.151-4 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

A method is described, based on K-matrix theory, for calculating the properties of finite nuclei. All nuclear interactions are assumed to take place in the S-state. (T.F.H.)

26657 (NP-10247(p.155-7)) STUDIES OF NUCLEAR MATTER BY MEANS OF NON-LOCAL SEPARABLE POTENTIAL. V. L. Narasimham (Aligarh Muslim Univ., Aligarh, India). p.155-7 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

A non-local separable potential is used to determine the properties of nucleons in nuclear matter. The effective masses (M) and binding energies (B) of the nucleons are calculated using the complete potential (i.e., considering both isotopic spin T = 0 and 1). Values of B = −13.9 Mev and M = 0.59 nucleon masses are found. (T.F.H.)

26658 (NP-10247(p.158-69)) ANGULAR CORRELATIONS IN THE FISSION PROCESS. R. Ramanna (India. Atomic Energy Establishment, Trombay). p.158-69 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The angular correlations in the fission of nuclei by photons, nucleons, deuterons, and alpha particles are studied. The fission-product anisotropy is studied as a function of the incident particle, the fission-product mass asymmetry, the fissioning nucleus, and the incident particle energy. (T.F.H.)

26659 (NP-10247(p.185-92)) LOW POWER THERMAL FLUX MEASUREMENTS IN THE CORE OF THE CANADA-INDIA REACTOR. V. C. Deniz, V. A. Gokhale, and K. V. Subba Rao (India. Atomic Energy Establishment, Trombay). p.185-92 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The thermal flux in the Canada India Reactor is measured using gold foil activation methods. The fuel channels in the CIR are arranged in a hexagonal configuration, with an empty central thimble. The axial and radial flux distributions are measured and fitted to sinusoidal curves. From the gold foil analysis, the reactor buckling and absolute power can be inferred. (T.F.H.)

26660 (NP-10247(p.193-9)) SOME PHYSICS CALCULATIONS OF C.I.R. R. C. Desai, B. P. Rastogi, K. R. Srinivasan, and M. S. Trasi (India. Atomic Energy Establishment, Trombay). p.193-9 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The Canada India Reactor is described, and its characteristics are reviewed. Comparisons are made between the observed and calculated reactivity, buckling, critical height, radial flux distribution, and reactivity worths of shut-off rods and various absorbers. (T.F.H.)

26661 (NP-10247(p.200-4)) REACTIVITY WORTH OF SHUT-OFF RODS IN C.I.R. M. S. Trasi (India. Atomic Energy Establishment, Trombay). p.200-4 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The reactivity worth of a ring of N symmetrically placed control rods in a cylindrical reactor is calculated, using two-group theory. The two-group critical equation is derived in a matrix form, which is convenient for numerical calculations and useful for comparisons with the one-group critical equation. The worths of the control rods in the Canada India Reactor are calculated as an example. (T.F.H.)

26662 (NP-10247(p.205-10)) REACTIVITY DUE TO AN INPILE LOOP IN C.I.R. M. S. Trasi (India. Atomic Energy Establishment, Trombay). p.205-10 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

A method is given for evaluating the reactivity of a central loop assembly in a cylindrical reactor. The method is used on a central loop in the Canada India Reactor, and compared with the results of the perturbation method and the direct diffusion method. The method requires only a small amount of numerical calculation. (T.F.H.)

26663 (NP-10247(p.211-17)) TWO GROUP THEORY OF A RING OF N CYLINDRICAL RODS OR ZONES IN A REFLECTED REACTOR. M. S. Trasi (India. Atomic Energy Establishment, Trombay). p.211-17 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, FEBRUARY 27–MARCH 2, 1961.

The two-group critical equation is derived for a cylindrical-reflected reactor that consists of a ring of N rods or zones. The two-group fluxes and currents are expressed in matrix form. The calculations are carried out for the cases in which the N elements are multiplying (rods) or non-multiplying (zones). (T.F.H.)

26664 (NP-10247(p.218-22)) CRITICALITY STUDIES OF PROJECT PHOENIX. R. Shankar Singh (India. Atomic Energy Establishment, Trombay). p.218-22 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

A study is made of the criticality conditions at the fuel reprocessing plant of the Canada India Reactor. The various stages in the fuel processing operation, whose purpose is to concentrate and recover the Pu^{239} produced in the reactor, are described. The criticality aspects of each stage are considered. (T.F.H.)

26665 (NP-10247(p.223-7)) CALCULATION OF EFFECTIVE RESONANCE INTEGRAL FOR CLUSTERS. K. R.

Srinivasan (India. Atomic Energy Establishment, Trombay). p.223-7 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The effective resonance integral for UO_2 clusters is calculated by four methods and compared with the experimental data. Air, D_2O, and H_2O are used as coolants; 7-, 19-, and 27-rod clusters are used; and the rods are clad with Al. (T.F.H.)

26666 (NP-10247(p.228-32)) BUCKLINGS OF ORGANIC COOLED HEAVY WATER MODERATED LATTICES. K. R. Srinivasan (India. Atomic Energy Establishment, Trombay). p.228-32 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

Measurements are made of the buckling of diphenyl-cooled, heavy-water-moderated, natural U fuel clusters. Seven- and nineteen-rod clusters are used. The buckling is measured as a function of the number of rods in the cluster, the rod diameter, the cell radius, and the minimum distance between the rods. The measurements are carried out in the ZERLINA assembly. (T.F.H.)

26667 (NP-10247(p.233-8)) A STUDY OF GRAPHITE POWER REACTORS. R. C. Desai (India. Atomic Energy Establishment, Trombay). p.233-8 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

Several calculational methods are described for determining the infinite multiplication constant k_∞ and the migration area L^2 for graphite power reactors. The results of these methods are compared for 5 Calder Hall type reactors, the Marcoule G-2 reactor, and the Chinon EDF-1 reactor. (T.F.H.)

26668 (NP-10247(p.239-44)) A CRITERION FOR INSTABILITY DUE TO TEMPERATURE TRANSIENTS. R. D. Jain and R. C. Desai (India. Atomic Energy Establishment, Trombay). p.239-44 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 12484.

26669 (NP-10247(p.245-9)) A FIVE-ZONE TWO GROUP ONE DIMENSIONAL CYLINDRICAL REACTOR PROGRAMME FOR THE TIFR DIGITAL COMPUTER. R. C. Desai and K. R. Srinivasan (India. Atomic Energy Establishment, Trombay). p.245-9 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The two-group diffusion equations, for a cylindrical homogeneous reactor that has a reflector consisting of five zones, are solved in one dimension by a digital computer program. The program flowsheet and formulae are reviewed. The values of the fluxes and the infinite multiplication constant k_∞ for the Canada India Reactor found by this program are in exact agreement with the expected values. (T.F.H.)

26670 (NP-10247(p.251-8)) CESIUM-137 AND STRONTIUM-90 IN MILK FROM NUCLEAR WEAPON TESTS. K. G. Vohra (India. Atomic Energy Establishment, Trombay). p.251-8 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The Cs^{137} and Sr^{90} activities in milk from 28 locations in India are shown, from Jan. 1958 to Dec. 1960. The Cs^{137} and Sr^{90} radiation levels of Indian milk are compared with those of other countries (Australia, Denmark, Germany, Holland, Britain, and the U. S. A.) for each of the three years considered. Factors influencing the Cs^{137} and Sr^{90} activity in the milk are discussed. (T.F.H.)

26671 (NP-10247(p.259-67)) SCINTILLATION SPECTROMETRY APPLIED TO RADIOACTIVE FALLOUT MEASUREMENTS. U. C. Mishra (India. Atomic Energy Establishment, Trombay). p.259-67 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

Methods are described whereby scintillation spectrometry may be applied to the measurement of low concentrations of gamma-emitters found in fall-out. Shielding and other means used to reduce the background intensity are outlined. The activities in milk, food, condiment, surface deposition, and airborne samples are measured by the methods described. Spectral peaks associated with Ba^{140}, La^{140}, Nb^{95}, Ru^{103}, Te^{132}, and Tc^{99} are detected. (T.F.H.)

26672 (NP-10247(p.268-76)) EXTERNAL GAMMA RADIATION DOSE FROM LONG RANGE FALLOUT. K. G. Vohra, C. Rangarajan, and Kumari G. Sarda (India. Atomic Energy Establishment, Trombay). p.268-76 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The β activities and γ doses from fall-out at Srinigar and Bombay, India, are given from Jan. 1957 to July 1960. These doses are measured at a height of 3 ft, so as to determine their genetic effects. The effects of several specific weapon tests are shown. Cumulative radiation effects are discussed. (T.F.H.)

26673 (NP-10247(p.277-84)) ESTIMATION OF LUNG-DOSE DUE TO INHALATION OF FALLOUT PRODUCTS IN THE AIR. K. G. Vohra and N. A. Ingle (India. Atomic Energy Establishment, Trombay). p.277-84 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The β lung dose from fallout at Bombay, Delhi, Calcutta, and Nagpur, India, is calculated over the period 1957 to 1960. The monthly and cumulative doses are calculated. The percentage of the infinity dose (dose at $t = \infty$) is found as a function of the time after inhalation and the time between the detonation and inhalation. (T.F.H.)

26674 (NP-10247(p.285-91)) A GRIDDED IONISATION CHAMBER—SINGLE CHANNEL ANALYSER SYSTEM FOR THE ESTIMATION OF ALPHA EMITTERS IN THE AIR. D. N. Kelkar (India. Atomic Energy Establishment, Trombay). p.285-91 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

A gridded ionization chamber is designed for detection of U or Pu in air in the presence of ThA, ThC, ThC′, RaC, and RaC′, by discriminating between the α energies of these isotopes. An α resolution of near 5% is obtained. The air to be sampled is drawn through a filter, and the activity remaining on the filter is placed in the ionization chamber. Using an air sampling rate of 120 liter/min and a sampling time of 3 hr, fair accuracy may be obtained for activities of about 0.5 dpm/m^3. (T.F.H.)

26675 (NP-10247(p.292-300)) A LOW PRESSURE CLOUD CHAMBER FOR THE STUDY OF REACTION PRODUCTS. M. Rama Rao (Saha Inst. of Nuclear Physics, Calcutta). p.292-300 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

A low-pressure cloud chamber is designed for the study of low-energy particle interactions. The counter may be controlled by a proportional counter. The characteristics of various alcohols used as filler gases are studied. (T.F.H.)

26676 (NP-10247(p.301-8)) POLARIZED PROTON BEAMS BY LAMB SHIFT METHOD. A. S. Divatia, M. R. Dwarakanath, and Joseph John (India. Atomic Energy Establishment, Trombay). p.301-8 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

A method is described for producing polarized proton beams, utilizing the Lamb separation between the $^2S_{\frac{1}{2}}$ and $^2P_{\frac{1}{2}}$ levels in H atoms. A beam is produced that consists predominantly of ^1S and ^3S states. A uniform magnetic field, at about 600 gauss, causes the upper $^2S_{\frac{1}{2}}$ sublevel to decay to ground, and a r-f field splits the remaining $^2S_{\frac{1}{2}}$ sublevel into its hyperfine components. The desired hyperfine component, which is polarized, is selectively ionized and separated from the un-ionized ground state beam. (T.F.H.)

26677 (NP-10247(p.309-13)) A DATA PROCESSING METHOD FOR NUCLEAR PULSE HEIGHT ANALYSIS. E. S. Rajagopal and K. Gopalan (Indian Inst. of Science, Bangalore). p.309-13 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

A single channel pulse height analyzer is described that has an accuracy of 1 or 2% at counting rates of around 4×10^4/sec. The single channel is swept over the spectrum in about 1000 overlapping scans of 400 counts each. (T.F.H.)

26678 (NP-10247(p.314-19)) A TRIPLE COINCIDENCE PROTON SPECTROMETER. R. K. Mohindra and H. S. Hans (Aligarh Muslim Univ., Aligarh, India). p.314-19 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

A proton spectrometer is designed for determination of the energy and angular distributions from (n,p) reactions on nuclei at 14 Mev. The spectrometer consists of three proportional counters, two behind the target (in coincidence) and one in front of the target (in anticoincidence). These counters determine true events and discriminate against charged particles other than protons. The protons stop in a CsI(Tl) crystal, and their energies are analyzed in 20-channel pulse height analyzer. (T.F.H.)

26679 (NP-10247(p.320-31)) THE ABSORPTION OF BETA-RADIATION AS A FUNCTION OF ATOMIC NUMBER. M. Ramakrishna Raju, V. Lakhminarayana, and Swami Jnanananda (Andhra Univ., Waltair, India). p.320-31 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

The absorption of β radiation by matter is, to a first approximation, dependent on the electron density in the absorbing medium, which is proportional to the absorber thickness T in $mg/cm^2 \cdot Z/A$. Thus the logarithm of the count rate (log R) should be proportional to T. For nuclei with $4 \leq Z \leq 79$, it is found that an additional dependence on Z occurs. The experimental data are fitted to curves of the form $\log R \sim TZ^n$, where n may be $\frac{1}{3}$ or $\frac{1}{2}$. Targets of Al, Zn, Sn, Au, Pb, and Pt– Rh alloy are used. (T.F.H.)

26680 (NP-10247(p.332-6)) A 4 π PROPORTIONAL COUNTER. S. C. Mishra (India. Atomic Energy Establishment, Trombay). p.332-6 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

A 4 π proportional counter is designed for absolute counting of β sources deposited on Mylar films. The counter is of the gas-flow type, and uses methane with CO_2, N_2, and H_2 impurities. An anode voltage of about 3.6 kv yields an intrinsic counter efficiency of 100%. (T.F.H.)

26681 (NP-10247(p.337-40)) DESIGN OF A NEW BAFFLE SYSTEM FOR THE THIN-MAGNETIC LENS BETA-RAY SPECTROMETER. A. S. Mahajan and Ambuj Mukerji (Tata Inst. of Fundamental Research, Bombay). p.337-40 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

A baffle system is designed to take advantage of an observed ring focus. An annular ring-baffle is placed at the position of the ring focus. A series of circular baffles is placed on both sides of the annular baffle, enveloping the caustic surface near the fing focus, thus eliminating the low energy tail of the line shape. The caustic surface formed by the electron trajectories is found photographically. (T.F.H.)

26682 (NP-10247(p.341-55)) MANY BODY ASPECTS OF DIPOLAR INTERACTION IN CRYSTAL LATTICES. R. Bersohn (Columbia Univ., New York) and T. P. Das (India. Atomic Energy Establishment, Trombay). p.341-55 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

The effects of dipolar interaction between magnetic dipoles in a crystal are studied. The line shapes of magnetic resonance lines (both electron spin resonance and nuclear magnetic resonance lines) are characterized, by finding the moments of these line shapes. Methods are given for finding the $2n^{th}$ moments (n = integer) of line shapes, including the effects of 2-, 3-, ... particle interactions. (T.F.H.)

26683 (NP-10247(p.357-64)) N.M.R. AND DIFFRACTION STUDIES OF THE STRUCTURES OF HYDRATES AND THE SHAPE OF THE BOUND WATER MOLECULE. R. Chidambaram (Indian Inst. of Science, Bangalore). p.357-64 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961 BOMBAY, FEBRUARY 27– MARCH 2, 1961.

By neutron diffraction and proton magnetic resonance techniques, the properties of bound water molecules in crystalline hydrates are investigated. The crystals $(COOH)_2 \cdot 2H_2O$, $Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$, $CuCl_2 \cdot 2H_2O$, $CaSO_4 \cdot 2H_2O$, $BaClO_3 \cdot H_2O$, $(CuSiO_3 \cdot H_2O)_6$, $Li_2SO_4 \cdot H_2O$, and $BaCl_2 \cdot 2H_2O$ are used in the study. It is found that the angle H–O–H in the bound water molecule is not appreciably different from the angle in free water vapor. It is concluded that the hydrogen bonds are bent, but that H–O–H angle remains fairly constant; this conclusion is justified by energy considerations. (T.F.H.)

26684 (NP-10247(p.365-71)) THE RING PROTON RESONANCE SPECTRA OF α, β AND γ PICOLINES. B. D. Nageswara Rao (Aligarh Muslim Univ., Aligarh, India). p.365-71 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

The NMR spectra of o-, m-, and p-picolines are determined, and the energy levels corresponding to the spectral lines are inferred. For each of these molecules, the differences in the Larmor frequencies of protons at various positions in the molecule are found, and the coupling between pairs of protons is determined. The spectra are found at 40 Mc. (T.F.H.)

26685 (NP-10247(p.372-8)) SPIN-LATTICE RELAXATION TIME IN TELLURIUM. R. Vijayaraghavan (Tata Inst. of Fundamental Research, Bombay). p.372-8 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

The spin-lattice relaxation time of Te is measured by magnetic resonance techniques. The observed times (28 to 60 sec) are compared with times calculated from semiconductor theory. The observed relaxation time requires that the conduction electron band in Te have a pronounced non-S-wave character. (T.F.H.)

26686 (NP-10247(p.379-83)) ELECTRON PARAMAGNETIC RESONANCE OF SOME CUPRIC SALTS. R. Rajan (Indian Inst. of Science, Bangalore). p.379-83 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The electron paramagnetic resonance spectra of cupric acid fluoride, cupric bromate, cupric malonate, and cupric tartrate are measured. All the salts are studied in powder form; in addition, the bromate and malonate salts are studied in single crystal form. The g values, line widths, and line shapes are tabulated. (T.F.H.)

26687 (NP-10247(p.384-7)) DESIGN AND CONSTRUCTION OF A NUCLEAR MAGNETIC RESONANCE ABSORPTION SPECTROMETER. S. Visweswara Murthy (Indian Inst. of Science, Bangalore). p.384-7 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

A radiofrequency spectrometer, of the marginal oscillator type is described. (T.F.H.)

26688 (NP-10247(p.388-99)) THE MILLIMETRE WAVE SPECTROSCOPY AND MASERS. Putcha Venkateswarlu (Aligarh Muslim Univ., Aligarh, India). p.388-99 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The energy levels and spectra of symmetric top molecules, particularly CH_3CN, are considered. The splitting of the levels by Coriolis forces and "l-type doubling" is studied. Each level corresponding to the quantum number K is found to split into three levels. The applications of this K splitting in the development of three-level masers and maser spectrometers are discussed. (T.F.H.)

26689 (NP-10247(p.400-12)) NEW SYNTHESES FOR CRYSTAL STRUCTURE ANALYSIS. G. N. Ramachandran (Madras. Univ.). p.400-12 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

Methods are presented whereby unknown parts of a crystal's structure may be inferred from the properties of known parts. The analysis is performed for L-tyrosine hydrochloride as an example, taking the chlorine atoms as the known part. (T.F.H.)

26690 (NP-10247(p.413-15)) THE ATOMIC AND THERMAL PARAMETERS OF KNO_3 AT 30°C AND 118°C. S. Ramaseshan, G. Sivasankara Rao, and M. A. Viswamitra (Indian Inst. of Science, Bangalore). p.413-14 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

Potassium nitrate crystals are orthorhombic from room temperature to 124°C, and they have the structure of aragonite. The anisotropy, structure factors, and atomic and thermal parameters of KNO_3 are measured at 30 and 118°C. (T.F.H.)

26691 (NP-10247(p.416-24)) THE DESIGN AND APPLICATION OF A WEISSENBERG CAMERA FOR STUDIES BETWEEN –180° AND 200°C. M. A. Viswamitra (Indian Inst. of Science, Bangalore). p.416-24 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The camera is equipped with a Dewar system for attaining steady low temperatures. Means are provided for growing the crystals in the camera. The gear system used to rotate the crystal and to translate the photographic film along the rotation axis is described. (T.F.H.)

26692 (NP-10247(p.425-8)) CRYSTAL SYMMETRY AND THE FERROELECTRIC BEHAVIOUR OF PYROLUSITE ($\beta-MnO_2$). K. Vedam (India. Atomic Energy Establishment, Trombay). p.425-8 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

Crystalline pyrolusite ($\beta-MnO_2$) is pyroelectric and ferroelectric at room temperature. It therefore belongs to a crystal class that has no center of symmetry. Measurements of its crystal structure, however, indicate that it is a member of the centrosymmetric $P4_2/mnm\text{-}D_{4h}^{14}$ group. It is suggested that the actual room temperature structure is $P4_2/nm\text{-}C_{4v}^4$, and that a transition occurs at about 50°C into the $P4_2/mnm\text{-}D_{4h}^{14}$ group. (T.F.H.)

26693 (NP-10247(p.429-30)) A CRYSTALLOGRAPHIC INVESTIGATION ON THE STRUCTURES OF SOME COORDINATION COMPOUNDS OF COBALT. N. R. Kunchur (India. Atomic Energy Establishment, Trombay). p.429-30 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

A study is made of the crystallography of cobalt(III) bisdimethylglyoximino diammine nitrate, cobalt(III) bisdimethylglyoximino perchlorate, cobalt(III) bisdimethylglyoximino thiocyanate, cobalt(III) bisdimethylglyoximino chloride, the sodium salt of the cobalt EDTA complex, and cobalt glycinate. The crystal structure of the first three of these compounds is studied in detail. (T.F.H.)

26694 (NP-10247(p.431-8)) INELASTIC SCATTERING OF NEUTRONS FROM IRON. P. K. Iyengar, N. S. Satyamurthy, and B. A. Dasannacharya (India. Atomic Energy Establishment, Trombay). p.431-8 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

The dispersion relation for longitudinal phonons along the 100 direction in bcc Fe is determined by the inelastic scattering of neutrons whose wavelength is 1.27 A. The dispersion relation is observed as a function of the neutron-phonon momentum exchange, and is compared with calculated values. (T.F.H.)

26695 (NP-10247(p.439-46)) INELASTIC SCATTERING OF THERMAL NEUTRONS BY LIQUID BISMUTH. K. Usha, G. Venkataraman, and P. K. Iyengar (India. Atomic Energy Establishment, Trombay). p.439-46 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The scattering of 0.0468 ev neutrons by liquid Bi at 300°C is studied. The angular and energy distributions of the scattered neutrons are found. The reciprocal transmission of neutrons in Bi and Pb is determined as a function of the scattering angle, and compared with the predictions of the gas model. (T.F.H.)

26696 (NP-10247(p.447-56)) SPECTROSCOPIC AND DECAY-TIME STUDIES IN THE LUMINESCENCE OF CsI(Tl). R. G. Lagu, N. P. Sastry, and B. V. Thosar (Tata Inst. of Fundamental Research, Bombay). p.447-56

of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The scintillation and fluorescence spectra of CsI(Tl) are compared, using 1.3 Mev γ rays, UV light at 2300 to 3600 A, and UV light 3000 to 4400 A. It is concluded that the luminescence centers for both types of spectra are identical. The decay times are measured for the luminescense components with wavelengths >4900 A and <5000 A, and for the total emission. In measuring the decay times, Po^{210} α- and Co^{60} γ-radiations are used to excite the crystal. The results are compared with those for other Tl-activated alkali halides. (T.F.H.)

26697 (NP-10247(p.457-65)) MAGNETIC AND LUMINESCENT PROPERTIES OF X-RAY AND γ-RAY IRRADIATED CRYSTALS OF LITHIUM FLUORIDE AND SODIUM CHLORIDE. Amalendu Choudhury (Jadavpur Univ., Calcutta). p.457-65 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

Single crystals of LiF and NaCl are irradiated at room temperature with x and γ radiation. The magnetic susceptibility, thermoluminescence, and optical absorption of the crystals are measured as functions of irradiation dose and temperature. The number of paramagnetic F centers formed by the irradiation is calculated from the thermoluminescence data and from the magnetic susceptibility data; the calculations disagree by a factor of 10. It is concluded that lattice detects other than color centers may be paramagnetic. (T.F.H.)

26698 (NP-10247(p.466-72)) A NEW POLY-TYPE OF SILICON CARBIDE-57 R. ITS STRUCTURE AND GROWTH. P. Krishna and A. R. Verma (Banaras Hindu Univ., Banaras, India). p.466-72 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The production of a crystalline form of SiC having a 57-layer repetition period along the c axis is reported. This crystal is shown to have the structure $[(33)_2 34]_3$ in the Zhadanov notation, and other structural features are noted. A mode of growth is suggested based on the dislocation theory. (T.F.H.)

26699 (NP-10247(p.473-6)) DISPERSION OF LATTICE WAVES IN COOPER. S. K. Joshi (Allahabad, India. Univ.). p.473-6 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The dispersion relations for longitudinal lattice waves propagating along the [110] direction in Cu are found by several theoretical approaches. The theoretical values are compared with values calculated from x-ray and slow neutron scattering experiments. (T.F.H.)

26700 (NP-10247(p.477-8)) LATTICE DYNAMICS AND THERMAL PROPERTIES OF CALCIUM FLUORIDE. S. Ganesan and R. Srinivasan (Indian Inst. of Science, Bangalore). p.477-8 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

A discussion is given of calculations of the dispersion relation, frequency distribution function, Gruneisen constants, and thermal properties of CaF_2. (T.F.H.)

26701 (NP-10247(p.479-87)) ELECTRICAL CONDUCTIVITY OF IRRADIATED CRYSTALS OF NaCl. S. C. Jain and D. N. Singh (India. National Physical Lab., New Delhi). p.479-87 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

Radiation effects on the electrical conductivity σ of NaCl are studied from 50 to 500°C. The ratio of σ for irradiated and unirradiated crystals, and the thermoluminescent intensity, are found as functions of the temperature. From these data, a model is proposed to explain the observed variations in σ. (T.F.H.)

26702 (NP-10247(p.488-93)) RADIATION ANNEALING OF RECOIL DAMAGE IN SOLID TRIS ACETYLACETONE Co(III) DISPERSED IN A MATRIX OF TRIS ACETYLACETONE Al(III). K. S. Venkateswarlu, Manoharlal, and J. Shankar (India. Atomic Energy Establishment, Trombay). p.488-93 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

Following neutron capture by Co nuclei in tris acetylacetonate Co(III), the damage may be annealed by γ- and x-irradiation of the sample. Some of this damage is annealed by reformation of the original molecule, and some by interaction of the recoiled atom with molecules in its immediate neighborhood. (T.F.H.)

26703 (NP-10247(p.494-8)) THE FLUORESCENCE SPECTRUM AT LIQUID AIR TEMPERATURE OF A SAMPLE OF URANYL SULPHATE OBTAINED BY HEATING THE TRIHYDRATE WITH SULPHURIC ACID. D. N. Pande and D. P. Khandelwal (D. S. B. Government Coll., Nainital, India). p.494-8 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

The fluorescence spectrum of uranyl sulfate (probably UO_2SO_4) is studied at −185°C. The spectrum as a whole is shifted toward the red as compared with that of $UO_2SO_4 \cdot 3H_2O$, the B_0 band having a shift of 245 cm^{-1}. Five spectral groups are studied, and the n^{th} group has n bands. Thus the first group has one band (B_0). (T.F.H.)

26704 (NP-10247(p.501-7)) DOUBLE BETA DECAY. S. Rama Murthy (Laboratories for Nuclear Research, Waltair, India). p.501-7 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

Theoretical and experimental aspects of double β decay are considered. Experiments show that the half lives for several of these processes vary from 10^{12} to 10^{21} years. The relation between double β decay and neutrino theory is shown. It is suggested that the reaction $Nd^{150} \rightarrow Pm^{150} \rightarrow Sm^{150}$ be studied, because of its short half life and high energy. (T.F.H.)

26705 (NP-10247(p.508-11)) A TIME-DEPENDENT APPROACH TO REARRANGEMENT COLLISIONS. Alladi Ramakrishnan, G. Ramachandran, and V. Devanathan (Madras. Univ.). p.508-11 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

A time-dependent S-matrix representation is found for the rearrangement collision interaction. By assuming the initial and final pairs of interacting particles to be identical, the S-matrix for simple scattering may be obtained. The deuteron stripping reaction is noted as an example of the use of the rearrangement collision S-matrix. (T.F.H.)

26706 (NP-10247(p.512-17)) MANIFESTLY RELATIVISTIC FORM OF THE DEFINITION OF UNIFORM ACCELERATION AND REMARKS CONCERNING ITS CONFORMAL INVARIANCE. Vachaspati and L. M. Bali (Lucknow, India. Univ.). p.512-17 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27–MARCH 2, 1961.

Uniform acceleration of relativistic particles is defined. A 3-dimensional definition is found in laboratory time (t).

A definition is found in several forms in 4-space, in the proper time (τ) of the accelerated particles. The relation between t and τ is shown. (T.F.H.)

26707 (NP-10247(p.518-20)) ON THE INTIMATE LINKING OF SPIN AND ORBITAL ANGULAR MOMENTUM IN THE ELECTRON THEORIES. M. Samiullah and R. Ramchander (Osmania Univ., Hyderabad, India). p.518-20 of PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, 1961, BOMBAY, FEBRUARY 27– MARCH 2, 1961.

The Barut theory of spin $\frac{1}{2}$ particles is considered, in which spin (Σ) and orbital angular momentum (L) conserve separately. It is shown that this separate conservation is a result of the transformation used to go from Dirac space to Barut space. It is also shown that irreducible spin representations arising in the Barut theory lead to an intimate linking of Σ and L. (T.F.H.)

26708 (NP-10451) DEVELOPMENT OF ION PROPELLANT SYSTEM. Quarterly Technical Progress Report No. 5, March 15, 1961 to June 15, 1961. Donald R. Snoke and P. J. Lawlor (Thompson Ramo Wooldridge Inc., Cleveland). June 26, 1961. Contract AF 33(616)-7219. 29p. (ER-4487)

A prototype propellant system was constructed with capabilities of storing 25 lb cesium and delivering cesium vapor at a median flow of 5×10^{-5} lb/sec at 14mm pressure. The prototype system was tested for endurance capabilities with cesium. The program for performance analysis is described. The development of a new low-flow metering device for liquid cesium flow rates of 10^{-5} to 10^{-7} lb/sec is discussed. (D.L.C.)

26709 (NRL-Memo-1177) STATUS REPORT ON THERMOELECTRICITY. J. W. Davisson and Joseph Pasternak (Naval Research Lab., Washington, D. C.). July 1961. 166p.

An extensive review of progress on thermoelectricity research is presented. The trend is toward improved Z values. Development of thermoelectric generators is also discussed. (D.L.C.)

26710 (SCR-264) WATER ENTRY TESTING USING ROCKET SLEDS. D. W. Bauder and D. L. Krenz (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 7p.

Presented at Proceedings of the Fifth National Meeting Institute of Environmental Sciences, Washington, D. C., Apr. 1961.

Tests of configurations in water entry using rocket sleds are described. It is noted that the results of these tests show that the rocket sled techniques offer many advantages over conventional testing methods for water entry studies, and information was obtained that should help improve future tests. (J.R.D.)

26711 (TG-331-9) TASK R—QUARTERLY PROGRESS REPORT NO. 9 FOR THE PERIOD APRIL 1–JUNE 30, 1961. (Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.). 29p.

Thermal Conductivity of Gases. The theory of the thermal conductivity of binary polyatomic mixtures is outlined, and experimental results are reported for N_2, CO_2, and N_2–CO_2 mixtures at high temperatures. Rocket Nozzle Fluid Dynamics. In studies using a typical solid propellent, a nozzle with larger radius of curvature of the throat section was found to give a smaller flow separation near the throat than the unmodified throat. Pitot tube boundary layer measurements are reported. Development of infrared spectroscopic equipment for studying the nozzle gas composition is described. Rocket Nozzle Chemical Kinetics. Analytical studies are being made of the chemical kinetics of the flow of real propellant gases through nozzles. Equations and numerical programs for machine calculations are presented and some of the encountered difficulties discussed. (D.L.C.)

26712 (UCRL-13013) DIFFRACTION OF ELASTIC WAVES IN SOLIDS: A COLLECTION OF ABSTRACTS. Jean-Pierre Fortin and John S. Rinehart (Colorado School of Mines Research Foundation, Inc., Golden). July 7, 1961. 25p. For Univ. of California Lawrence Radiation Lab.

A compilation of abstracts of articles on diffraction of elastic waves in solids is presented. They deal with specific problems which are expressed in mathematical form or furnish other methods for solving such problems. The subject is relatively new and the expressions given under a mathematical form require the very cumbersome evaluation of definite integrals together with the long preparation of a program of computations. (J.R.D.)

26713 (JPRS-7009) EFFECTS OF SMALL QUANTITIES OF RARE EARTH OXIDES ON THE MAGNETIC BEHAVIORS OF A VARIETY OF RECTANGULAR LOOP FERRITE CORES. Kuo-tung Li, Hsin-ling Wang, and Fu-k'uang Hsiao. Translated from Wu Li Hsüeh Pao, 16: 272-9(May 1960). 18p.

An account is given of the effects of small quantities of rare earth oxides (La_2O_3, CeO_2, Sm_2O_3, Gd_2O_3, and Y_2O_3) on the magnetic behaviors of a variety of Mg– Mn rectangular loop ferrite cores containing ZnO and CuO. The static hysteresis loop, saturation magnetization, curie point, and noise ratio of signals are determined. Examples are given to show the effects of dimension of magnetic cores on the rectangularity ratio and of the quenching temperature and the contents of rare earth oxides on the noise ratio of signals. (P.C.H.)

26714 (JPRS-8706) DEVELOPMENTS IN SPECTROSCOPY IN COMMUNIST CHINA. Translated from Wu Li Hsueh Pao, 15: 277-340(June 1959). 106p.

Developments in spectroscopy are discussed. Topics covered include: manufacture of a spectroscope for steel analysis, application of spectroscopic analysis to powdered samples of electro-vacuum materials, improvement of accuracy in the spectrochemical analysis of high-alloy steels, construction of a photoelectric spectrophotometer, layer by layer analysis of aluminized steel by the spectrum line width method, spectroscopic analysis of impurities in metallic zirconium, an automatic device for Type ISP-22 medium quartz spectrograph, a photoelectric direct-reading attachment to a medium quartz spectrograph and analysis of copper in aluminum alloys, determination of impurities in pure antimony by quantitative spectral analysis, quantitative spectral analysis of platinum in a petroleum catalyst having aluminum oxide as a carrier, and group analysis of hydrocarbons by the integral intensities of infrared spectra. (M.C.G.)

26715 (NP-tr-712) DIRECT CONVERSION OF NUCLEAR ENERGY INTO ELECTRICAL ENERGY. Nguyen Van Dong. Translated by E. Towndrow for U.K.A.E.A. Atomic Energy Research Establishment from Bull. inform. sci. et tech. (Paris), No. 41, 14-27(1960). 43p. (Handwritten MS.).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 26093.

26716 (NP-tr-720) THE STRUCTURE OF SLOW MAGNETOHYDRODYNAMIC SHOCK WAVES WITH BAROTROPY. A. G. Kulikovskii (Kulikovskiy). Translated from Doklady Akad. Nauk S.S.S.R., 137: 810-13(1961). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 20265.

26717 (NP-tr-721) SELF-SIMILAR SOLUTIONS OF THE EQUATIONS OF A LAMINAR BOUNDARY LAYER IN MAGNETOHYDRODYNAMICS. N. I. Pol'skii (Pol'skiy) and I. T. Shvets. Translated from Doklady Akad. Nauk S.S.S.R., 136: 1051-4(1961). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 17651.

26718 (NP-tr-729) CERTAIN FEATURES OF THE TRANSVERSE PROPAGATION OF HIGH-FREQUENCY WAVES IN MGANETOACTIVE PLASMA. B. N. Gershman. Translated from Doklady Akad. Nauk S.S.S.R., 137; 822-5 (1961). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 20266.

26719 (NRL-Trans-569) OPTICAL INVESTIGATION OF ADSORPTION AND SURFACE CONDENSATION OF VAPORS NEAR SATURATION. B. V. Deryagin (Deriagin) and Z. M. Zorin. Translated by A. Pingell from Naval Research Lab. from Doklady Akad. Nauk S.S.S.R., 98: No. 1, 93-6(1954). 9p.

Investigations were made of the polymolecular adsorption and vapor condensation on smooth surfaces. The apparatus employed is described. The adsorption was studied on the surface of polished plane parallel plate which had a flat connection without grease, but with external mercury packing. The liquids, whose vapors were studied, included water, CCl_4, pentane, benzene, nitrobenzene, and various alcohols. Results indicated that for polar substances the isotherm intersects the saturation ordinate. For non-polar substances, on the contrary, it was found that the isotherm asymptotically tends toward the ordinate. (M.C.G.)

26720 (SCL-T-374) ON THE SHOCK WAVES TRANSMITTED IN CONICAL BARS. Takeshi Kanazawa. Translated by Noburu Hiraga for Sandia Corp. from Ôyô-rikigaku, 1: 133-41(1948). 17p.

Studies were made of elastic shock waves transmitted in conical bars. Results were compared with the case of uniform cross section bars. General longitudinal and transverse shock waves and the case of a harmonic vibrating source were considered. The characteristic of the wave was due to the effect of the variation in cross-sectional area. (M.C.G.)

26721 ON THE INFLUENCE OF A MAGNETIC DIPOLE UPON THE GRAVITATIONAL FIELD. Jaroslav Pachner (Technical Univ., Prague). Acta Phys. Polon., 20: 475-92 (1961). (In English)

The influence of a magnetic dipole upon the gravitational field is investigated under the assumptions of a body with spherically symmetrical distribution of mass and with a weak magnetic moment. The resultant relations prove that the magnetic dipole exhibits also a weak gravitational quadrupole. The discussion of the results shows that the general relativity theory can play a certain role in the future quantum theory of elementary particles, and that there exist no measurable differences between the general relativity theory of Einstein-Maxwell and the unified field theory considered in this paper in the domains outside the elementary particles. A concluding remark deals with the influence of the magnetic fields in interstellar matter on the curvature of the universe. (auth)

26722 GENERATION OF PLASMA JETS HAVING HIGH TEMPERATURES AND VELOCITIES. Th. Peters (Forschungsinstitut für Physik der Strahlantreibe e.V., Stuttgart, Ger.). Astronaut. Acta, 7: 150-70(1961). (In German)

Following a brief historical survey concerning the physics of thermal plasmas several types of electric arc chambers are discussed, by means of which high plasma temperatures and plasma jet velocities are available with continuous operation. In particular, the significance of astrophysical research for plasma physics is emphasized. (auth)

26723 ON A BOUNDARY-LAYER PHENOMENON IN MAGNETO-FLUID DYNAMICS. W. R. Sears (Cornell Univ., Ithaca, N. Y.). Astronaut. Acta, 7: 223-36(1961). (In English)

The class of steady plane and axisymmetric magneto-hydrodynamic flows known as "aligned-field flows" is defined. For such flow of an ideal inviscid conductor about a closed solid body of finite conductivity there appears a vortex-and-current sheet at the fluid-solid interface. In this paper this phenomenon is studied under the hypotheses of large magnetic Reynolds number Rm and very small magneto-hydrodynamic Prandtl number Pr_m. It is pointed out that this fluid property has, indeed, very small values for real conducting fluids. It is shown that the vortex-and-current sheet is actually a boundary layer. This in turn is made up of two recognizable layers: an inviscid boundary layer of thickness $O(Rm^{-1/2})$ and a viscous sublayer of thickness $O(Pr_m^{1/2} Rm^{-1/2})$. The approximate differential equations appropriate to these two layers are deduced. Because the orders of magnitude of the magnetic-field components within the body are not known a priori, the processes of reaching these conclusions, of deducing the equations, and of determining the orders of magnitude of these boundary values are inseparable. Finally, it is shown that, in spite of obvious contrasts with conventional boundary-layer theory, some of the well-known methods of that theory are applicable to the problem of the inviscid boundary layer. These include (1) Mangler's transformation, and (2) "similar" solutions for symmetrical stagnation-point flows past wedges. (auth)

26724 THE SCATTERING OF BEAMS OF ALKALI ATOMS IN VARIOUS GASES. II. SODIUM ATOM BEAM IN NON-REACTIVE AND REACTIVE GASES. Kumasaburo Kodera and Teijiro Tamura (Kyoto Univ.). Bull Chem. Soc. Japan, 34: 566-71(Apr. 1961). (In English)

Weakening of sodium beams scattered in Ar, He, H_2, CO, CO_2, Ne, N_2, NO, and O_2 is graphically shown. Calculated results are presented for relative pressures of scattering gas in the scattering-, the oven-, and the detector-chambers; mean free paths at 10^{-4} mm Hg; effective collision radii; collision cross sections; and classical kinetic values. (N.W.R.)

26725 RADIO-FREQUENCY BREAKDOWN CONTROLLED BY DRIFT OF ELECTRONS IN AN INHOMOGENEOUS MAGNETIC FIELD. L. T. Shepherd and H. M. Skarsgard (Univ. of Saskatchewan, Saskatoon). Can. J. Phys., 39: 983-92(July 1961).

A study has been made of r-f breakdown in which the controlling loss mechanism arises from the drift of electrons in an inhomogeneous magnetic field. The study was carried out using a toroidal system with parallel r-f electric and steady magnetic fields. An approximate average-electron theory of drift-controlled breakdown is presented. Experimental measurements of breakdown r-f electric field versus magnetic field were made at various pressures from 1.25 to 6.0×10^{-3} mm of Hg, using hydrogen and helium gases. A radio frequency of 8-Mc/sec was used. Magnetic fields up to 2000 gauss were employed. The r-f breakdown field was found to vary as the inverse square root of the magnetic field as predicted by the theory. (auth)

26726 WAVES IN A RAREFIED IONIZED GAS PROPAGATED TRANSVERSE TO AN EXTERNAL MAGNETIC

FIELD. Tomiya Watanabe (Univ. of Maryland, College Park). Can. J. Phys., 39: 1044-57(July 1961).

Waves being propagated in a rarefied and fully ionized gas and transverse to an external magnetic field have been studied, particularly hydromagnetic waves. Three modes of waves, in which the perturbed magnetic field is parallel to the external magnetic field, are found to be propagated. In a high-frequency limit, they tend to electromagnetic waves, electron sound waves, and ion sound waves. In the condition that the Alfvén velocity is greater than the ion sound velocity but smaller than the light velocity, the last mode tends to a hydromagnetic wave in the low-frequency limit. The other two modes of waves can be propagated only at frequencies higher than the critical frequencies, both of which almost equal the electron plasma frequency. The condition that hydromagnetic waves should be attenuated severely due to collisions between electrons and ions has been derived. (auth)

26727 INELASTIC SCATTERING OF NEUTRONS FROM ROTATING LIQUID HELIUM II. A. D. B. Woods (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1082-4(July 1961). (AECL-1262)

An attempt was made to learn whether macroscopic rotation of liquid helium II changes the character of the energy–momentum dispersion curve for the Landau excitations. Neutrons with an initial wavelength of 4.06 Å were scattered from liquid helium through an angle of 81.25° and were then energy analyzed. The helium was in a chamber containing a bucket. The bucket was rotated with the helium at 1.5°K. The roton line width broadened so that further increase in rotation should have been detectable; no effect was observed. (L.N.N.)

26728 EFFECT OF NITRIC ACID ON THE SENSITIVITY TO α PARTICLES OF NUCLEAR PLATES AND ON THE EFFACEMENT OF THE TRACKS. Robert Chasset. Compt. rend., 252: 3976-8(June 19, 1961). (In French)

Some α nuclear plates, immersed in dilute nitric acid, then washed with alcohol, have their sensitivity reduced only if the subsequent α irradiation takes place in the 15 minutes following the removal of the plates from the rinsing bath. When a plate is impregnated with polonium in nitric acid, it can be considered that the α tracks are registered only from the moment when the plate is removed from the bath. (tr-auth)

26729 BULLETIN DU GROUPEMENT D'INFORMATIONS MUTUELLES AMPÈRE COMPTE RENDU DU 9^e COLLOQUE, PISE, 12-16 SEPTEMBRE 1960. (Bulletin of Ampère Group for Mutual Information. Report of the Ninth Colloqium, Pisa, September 12-16, 1960). Compt. rend. colloq. ampère, 9^e colloq., Pise, 1960, p.1-711.

One hundred and twenty two of the papers presented at the Colloque at Pisa and the discussions following the papers are compiled. The topics discussed are (1) dielectric relaxation, paramagnetic relaxation, hertzian molecular spectra, and ultra-hertzian optics; (2) electron paramagnetic resonance; and (3) nuclear and quadrupole magnetic resonance. Fifteen of the papers are individually abstracted for NSA. (J.S.R.)

26730 SPIN-LATTICE RELAXATION IN CERIUM MAGNESIUM NITRATE AT HELIUM TEMPERATURES: A NEW PROCESS. C. B. P. Finn, R. Orbach, and W. P. Wolf. Compt. rend. colloq. ampère, 9^e colloq., Pise, 1960, p.108-10. (In English)

Measurements of the spin-lattice relaxation time T_1 of a single crystal of $Ce_2Mg_3(NO_3)_{12} \cdot 24H_2O$ were made in the liquid helium range by the Casimir–du Pre method at frequencies between 175 and 900 c/sec and d.c. fields of 300, 600, and 1000 gauss. In all fields an extremely rapid variation of T_1 with temperature was observed. No paramagnetic resonance absorption was observed above 10°K. The relaxation at the temperatures studied occurs by a two-stage process, each step of which is a single phonon (or "direct") process. The absolute magnitudes of relaxation times were calculated as $T_1 \sim 10^{-10}\, e^{34/T}$ sec in satisfactory agreement with experiment. (J.S.R.)

26731 SPIN-LATTICE RELAXATION IN SOME RARE EARTH ETHYLSULPHATES. A. H. Cooke, C. B. P. Finn, and R. Orbach (Clarendon Lab., Oxford). Compt. rend. colloq. ampère, 9^e colloq., Pise, 1960, p.111-12. (In English)

Spin-lattice relaxation measurements were made of the ethyl sulfates of Nd, Dy, Er, and Yb at temperatures in the liquid helium range to discover if the relaxation mechanism is by direct phonon transitions between the ground doublet state and a low-lying excited state of the magnetic ions. The Dy and Yb salts showed the relaxation time T_1 is proportional to Δ/kT where Δ is the energy of the excited state. Nd and Er showed a quite different temperature dependence. It appears that the probability of phonon-induced transitions in Nd and Er is small. (J.S.R.)

26732 MAGNETIC RESONANCE OF ATOMIC LEVELS IN Zn AND He-4 EXCITED BY ELECTRON BOMBARDMENT. B. Decomps, A. D. May, and J. C. Pebay-Peyroula. Compt. rend. colloq. ampère, 9^e colloq., Pise, 1960, p.138-42. (In French)

When atoms are bombarded with low energy electrons, some of the emitted lines are polarized. This property can be used to extend the Kastler-Brossel method of double resonance to the study of excited levels. Four resonances were observed on zinc vapor bombarded at a pressure between 10^{-3} and 10^{-4} mm Hg. The magnetic resonances of the levels 3^1D, 4^1D, 5^1D, and 3^3P of He^4 were observed, and their polarizations were determined as a function of the electron energy. (J.S.R.)

26733 SOME INTERACTION PHENOMENA BETWEEN CENTIMETER WAVES AND IONIZED GASES. G. Fornaca, M. Ciampi, and M. Reinharz (Università, Pisa, Italy). Compt. rend. colloq. ampère, 9^e colloq., Pise, 1960, p.165-70. (In French)

During a series of studies on the properties of plasma a phenomenon connected to the magnetic resonance of electrons was observed. The effect consists in a direct coupling produced by the plasma between two wave guides. The aim of the present work is to give a description of the details of this effect, established by preliminary experiments. The plasma is produced in a Pyrex tube filled with a rare gas at a pressure from several millimeters to 10 cm Hg. The experimental apparatus is described in some detail. (J.S.R.)

26734 STUDY OF SOLIDS WITH PARAMAGNETIC RESONANCE. E. E. Schneider (King's Coll., Newcastle upon Tyne, Eng.). Compt. rend. colloq. ampère, 9 colloq., Pise, 1960, p.183-93. (In French)

The application of electron spin resonance to the study of solid solutions in ionic crystals and of electronic conduction phenomena in semiconductors and metals is briefly discussed. The formation of electron and hole centers in alkali halides is considered as a model case of radiation effects in solids. The investigation of such centers by ordinary and double resonance techniques is surveyed, including some recent results on irradiated LiF. (auth)

26735 INVESTIGATIONS ON U.V. IRRADIATED LITHIUM HYDRIDE CRYSTALS BY ELECTRON RESONANCE. D. J. E. Ingram and M. J. A. Smith (University Coll., North Staffordshire, Keele, Eng.). Compt. rend. colloq. ampère, 9e colloq., Pise, 1960, p.213-18. (In English)

Lithium hydride and lithium aluminum hydride crystals were irradiated with uv radiation of 2537 Å, and detailed optical absorption studies were made. Absorption lines were observed at room temperature and at low temperatures. The absorption intensities were determined by comparison with signals from a standard free radical sample. In all lithium hydride crystals a single resonance of $g = 2.002 \pm 0.001$ with a half width of 0.3 gauss was observed. This resonance line is temperature independent, showing that the unpaired electrons obey a Fermi-Dirac statistic. These results prove that uv produces colloidal particles of Li metal scattered through the sample. The uv irradiation of lithium aluminum hydride crystals does not result in the formation of colloidal particles of metal. (J.S.R.)

26736 STOCHASTIC THEORY OF NUCLEAR MAGNETIC RESONANCE IN ROTATING SOLIDS. S. Clough (University Coll., North Wales, Bangor). Compt. rend. colloq. ampère, 9 colloq., Pise, 1960, p.374-8. (In English)

Dipolar broadening is described by a random function characterized by two parameters ω_1 and ω_2 which determine the widths of its Gaussian probability distribution and its Gaussian frequency spectrum. With this model, a general method for obtaining the spectrum of a rotating sample is given. When the axis of rotation is inclined at 54 degrees to the magnetic field, an approximate criterion for the spectrum to exhibit structure is $\exp - (3\pi^2\omega_1^2\omega_2^2/4\omega_r^4) \sim \omega_r/2\pi\omega_1$, where ω_r is the rotational angular frequency. At high rotation frequencies the central line has the width $(2\pi)^{1/2}(2\omega_1^2/3\omega_2) \exp - (\omega_r^2/2\omega_2^2)$. (auth)

26737 TRANSITION RADIATION OF DIPOLE MOMENTS. A. Ts. Amatuni (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 13: 111-20(1960). (In Russian)

The transition radiation of two charges e and ±e passing with a uniform velocity from the first into the second medium in a direction normal to the boundary plane has been examined. The magnetic dipoles formed by poles of opposite sign and their radiation were studied, following the approach used for the investigation of the Cherenkov radiation. Formulas were derived for calculating the transition energy, taking the electric moment also into consideration. Results of the calculations indicated that the radiation induced by the magnetic moment of an electron or a neutron is practically nonexistent under certain conditions, i.e., the average number of transition quanta is extremely small. The formulas obtained apply only for moments derived from particle agglomerations which are able to generate transition radiation, in particular in the microwave range. (TTT)

26738 DEPENDENCE OF THE INTENSITY OF REFLECTED X-RAYS ON THE DIMENSIONS OF THE REFLECTING SINGLE CRYSTAL. P. A. Bezirganyan and I. B. Borovskii (Erevan State Univ., USSR and Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 13: 121-39 (1960). (In Russian)

Laue's kinematic theory of the interference phenomena of x rays does not explain the dimensional effect of the reflecting single crystal on the intensity of the reflected radiation; it is applicable only for crystals which are smaller, while Darwin's dynamic theory can be used only for crystals larger than the first Fresnel zone. The correction used by Darwin for the primary extinction considers only the dependence of the intensity of the reflected radiation on the thickness of the crystal and is therefore inaccurate for crystals with reflecting planes larger than 10^{-2} cm. Reduction of the intensity with increasing dimensions of the crystal was up to now explained by the dynamic theory of x ray interference; however, the calculations derived show that this reduction is due at least partially to kinematic factors. Darwin's theory does not allow the precise determination of the index of refraction for crystals smaller than 10^{-2} cm; a correction factor must be used to make the theory applicable to crystals of any dimension. (TTT)

26739 INVESTIGATION OF HYPERFRAGMENTS IN NUCLEAR EMULSIONS. Kh. P. Babayan, N. A. Marutyan, K. A. Matevosyan, and M. G. Sarinyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 13: 165-8(1960). (In Russian)

A nuclear emulsion irradiated at the time of the 1955 expedition in Italy at a height of 27 km was systematically examined for evidence of hyperfragments. An Ilford G-5 type emulsion with 600 μ layers was used. The enlargements were inspected for binary stars on the basis of the following criteria: length of the track of connecting particles ≥ 20 μ; no possibility of nuclear interactions on the basis of track characteristics, such as thickness, density of δ rays, scattering, etc.; total charge corresponding to the charges of the connected particles; and availability of kinematic analysis data of the decay products of hyperfragments. Six cases were found to fulfill these conditions. The primary stars were tracked to the container wall or to stoppage. In no case was the birth of a hyperfragment together with other unstable particles observed. The energy of the secondary particles was determined from the range-energy ratio or on the basis of ionization changes. (TTT)

26740 DEPOLARIZATION OF A BEAM MOVING IN A NONUNIFORM MAGNETIC FIELD. Yu. F. Orlov and S. A. Kheifets (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 13: 169-71(1960). (In Russian)

Change of the polarization of the particle rotating in a magnetic field may be used for measuring the magnetic moment of μ particles such as electrons or μ mesons. The number of rotations must be quite high (10^8) and for this reason the magnetic field must be focused, making it nonuniform, to prevent the escape of the particles during the experiment. Equations were derived for calculating the motion of particles with given charge, mass, and spin in an electromagnetic field, and solved for the case of magnetic field. (TTT)

26741 VAPOR PRESSURES OF THE NEON ISOTOPES. Jacob Bigeleisen and Etienne Roth (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys. 35: 68-77(July 1961). (BNL-5100)

The ratio of the vapor pressures of Ne^{20} and Ne^{22} were measured in the temperature range 16–30°K. An accuracy of about 1% in the logarithm of the vapor-pressure ratio was achieved. The latter is checked by comparisons of triple-point pressures, equilibrium fractionation experiments, and the entropy difference of the condensed phases with thermal measurements. The Debye temperature for the solid derived from the ratio of the vapor pressures was 74.6°K. The discrepancy between the characteristic

temperatures derived from measurements of free energy with those from heat capacities is attributed to the role of the anharmonicity of the lattice. It is shown that the difference in the thermodynamic properties of solid and liquid neon in the vicinity of the triple point can be attributed to the change in coordination number. (auth)

26742 ELECTRICAL RESISTIVITY OF CUBIC SODIUM TUNGSTEN BRONZE. L. D. Ellerbeck, H. R. Shanks, P. H. Sidles, and G. C. Danielson (Ames Lab., Ames, Iowa). J. Chem. Phys., 35: 298-302(July 1961). (IS-226)

The electrical resistivities of the nonstoichiometric compounds Na_xWO_3 were measured as a function of sodium concentration from x = 0.48 to x = 0.88, and as a function of temperature from 4° to 873°K. The minimum in electrical resistivity near x = 0.75, was absent in single crystals which were selected to be electrically homogeneous. Above room temperature, the electrical conductivity increased approximately linearly with sodium concentration; at liquid-helium temperatures, the electrical conductivity increased approximately as the fourth power of sodium concentration. (auth)

26743 ON THE REFLECTION AND REFRACTION OF HYDROMAGNETIC WAVES IN IONISED GAS. Tomikazu Namikawa (Osaka City Univ.). J. Geomagnet. Geoelec., 12: 117-28(1961). (In English)

Hydromagnetic wave propagation in the Earth's upper atmosphere is of interest. The density changes continuously in the atmosphere and the steady magnetic field is a dipole field, but the discussion is here confined to reflection and refraction of hydromagnetic waves at a plane boundary between two semi-infinite homogeneous media of anisotropic electrical conductivity under a uniform steady magnetic field. When the steady magnetic field is perpendicular to the boundary plane the laws of reflection and refraction are simple, but when the steady magnetic field makes an angle with the plane, they are complicated. The incident ordinary (or extraordinary) waves may be reflected or refracted as the ordinary or extraordinary waves and propagate anisotropically. (auth)

26744 IN-PLACE MEASUREMENT OF PERMEABILITY IN HETEROGENEOUS MEDIA. II. EXPERIMENTAL AND COMPUTATIONAL CONSIDERATIONS. R. William Nelson (General Electric Co., Richland, Wash.). J. Geophys. Research, 66: 2469-78(Aug. 1961). (HW-SA-2099)

The computational problem pointed out in part 1 (J. Geophys. Research 65, 1753-58(1960)) is evaluated in some detail. The problem arises from the need for compromise between the accuracy of calculated permeability and the ease of performing the calculation. Finite difference methods were expected to provide such a compromise. However, imprecision in numerical differentiation prevented use of the difference method. A study of the accuracy required for measuring permeability indicates that 7.5 times as much variation is allowable in the permeability as in the potential pattern. Since potential patterns are the tools needed to treat practical problems, errors in permeability measurements as great as 37 to 75 per cent may be tolerated and still provide answers within the common engineering accuracy range of 5 to 10 per cent. Linear flow approximations are found to give rather reliable permeability results for lateral flow systems. The geometrical shape of net elements in a properly constructed flow net for heterogeneous soils is utilized in the method. An expression for the approximation error is presented for application to any problem being analyzed. (auth)

26745 ELECTRON DENSITIES IN THE OUTER IONOSPHERE DEDUCED FROM NOSE WHISTLERS. R. L. Smith (Univ. of Hawaii, Honolulu). J. Geophys. Research, 66: 2578-9(Aug. 1961).

Discrepancies are noted in a nose whistler dispersion attempt to determine electron densities in the outer ionosphere (NSA 15: 9589). Apparently, errors were made in calculations; after suitable corrections, electron densities deduced from Pope's data are reasonably close to those by Smith and Allcock. (L.N.N.)

26746 SOME COMMENTS ON OBTAINING ELECTRON DENSITIES IN THE EXOSPHERE USING NOSE WHISTLERS. Joseph H. Pope (Geophysical Inst., Coll., Alaska). J. Geophys. Research, 66: 2580-1(Aug. 1961).

A defense of nose whistler data on electron densities in the exosphere is made (see NSA 15: 9589). Observed signals were assumed to be "long" whistlers, whereas the critic of these data assumed "short" whistlers to be the case. Discrepancies in the critic's paper are pointed out in that he used the gyrofrequency model of electron density distribution whereas the author used the Johnson model. (L.N.N.)

26747 EXPERIMENTAL VERIFICATION OF THE SPACE CHARGE LAW ($I = k(e/m)^{\frac{1}{2}}V^{\frac{3}{2}}$) FOR ION BEAMS FROM A PLASMA ION SOURCE. W. L. Rautenbach (National Physical Research Lab., Pretoria). Nuclear Instr. & Methods, 12: 169-79(June 1961). (In English)

Application of the space charge law to ion beam formation using plasma ion sources as well as the results of previous experiments to verify this law are briefly discussed. By strictly observing the conditions under which this law may be applied, it is possible to verify the space charge law experimentally for a magnetic ion source with end extraction using the acceleration system of a laboratory isotope separator. The problems encountered in proving the space charge law show that caution must be exercised in applying the law, especially to ion beams from different types of ion sources, as the discharge conditions under which the law holds must first be established for each type. (auth)

26748 THE PREPARATION OF THIN ^{18}O TARGETS. A. H. F. Muggleton and F. A. Howe (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 12: 192-4(June 1961). (In English)

A technique is described for producing thin films containing O^{18}, suitable for nuclear spectroscopy. Tungsten oxide is first prepared from heavy water enriched in O^{18}; it is then evaporated in vacuum on to thin carbon backings. (auth)

26749 THE ANALYTICITY DOMAIN OF THE FOUR POINT FUNCTION. Gunnar Källén (Univ. of Lund, Sweden). Nuclear Phys., 25: 568-603(1961). (In English)

A characterization of the boundary curves determining the analyticity domain of the four point function is given. Only the analyticity domain that follows when local commutativity of the field operators is not invoked is investigated. The domain turns out to be bounded by obvious generalizations of the surfaces one has for the three point function and by an entirely new surface which is not an analytic hypersurface. The equation of the new surface is investigated in some detail and its properties are illustrated with numerical plots. (auth)

26750 THE INFLUENCE OF PRESSURE ON THE MOBILITY OF ELECTRIC CHARGES IN LIQUID HELIUM II. S. Cunsolo and P. Mazzoldi (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10), 20: 949-55(June 1, 1961). (In English)

The mobility of positive and negative charges in liquid helium II has been measured as a function of the pressure, for pressures ranging from the vapor pressure to the

melting point, in the temperature range 1.9 to 1.1°K. The mobility of the positive charges was found to decrease with the increasing pressure, but this decrease cannot be accounted for in terms of the known change in the roton density. The negative charges behave in a peculiar way which can be easily accounted for by the bubble model. For both charges an unexplained sharp break is found at about 1.3°K especially at the higher pressures. (auth)

26751 UNITARITY CONDITIONS IN TERMS OF PROPAGATION KERNELS. E. R. Caianiello and H. Umezawa. Appendix by B. Preziosi (Università, Naples). Nuovo cimento (10), 20: 1001-9(June 1, 1961). (In English)

If the group property (macroscopic causality) of the U-matrix is postulated, the proof of its unitarity reduces to a simple verification on the propagation kernels of the theory. An explicit proof is given of that property for electro- and meso-dynamics by means of perturbative expansions, which may be easily generalized. (auth)

26752 STATISTICAL THEORY OF THE DIELECTRIC CONSTANT OF AN IMPERFECT GAS. Allan N. Kaufman and Kenneth M. Watson (Univ. of California, Berkeley and Livermore). Phys. Fluids, 4: 931-43(Aug. 1961). (UCRL-9559)

By means of the linked-diagram expansion of the grand partition function of a molecular gas in an electrostatic field, an expression for the polarization P(R) of the gas is obtained. Spatial variation of the external electric field $E_0(R)$ requires an explicit treatment of long-range cooperative interactions between "clusters" of molecules. For fields that vary appreciably over microscopic dimensions, an integral relation is found relating the polarization P(R) to the electric field E(R). For fields varying negligibly over microscopic regions, an expression for the dielectric constant K of the gas is obtained: $(K-1)/(K+2) = (4/3)\pi \sum_{m=1}^{\infty} n^m \alpha_m(\theta)$. This generalization of the Clausius-Mossotti formula involves the density n and the temperature-dependent polarizabilities of m-molecule linked clusters: $\alpha_1(\theta)$ is the effective polarizability of a single (possibly polar) molecule; $\alpha_2(\theta)$ is the diagonal element of the scalar tensor $\alpha_2(\theta) = \int d^3R \exp[-\beta\Phi(\theta, R)][\frac{1}{2}\alpha_2(\theta, R) - \alpha_1(\theta)]$. In this expression $\alpha_2(\theta, R)$ is the effective polarizability tensor of two molecules with fixed positions of their centers of mass; Φ is the free energy of the two-molecule system, relative to infinite separation. (auth)

26753 ESTIMATED COLLISION INTEGRALS FOR THE EXPONENTIAL ATTRACTIVE POTENTIAL. Richard S. Brokaw (Lewis Research Center, Cleveland). Phys. Fluids, 4: 944-6(Aug. 1961).

Collision integrals for the exponential attractive potential $\varphi(r) = -A\exp(-r/\rho)$ were estimated from the known integrals for the inverse power attractive potentials $\varphi(r) = -ar^{-n}$. The exponential attractive potential should be suitable for interactions between atoms or free radicals corresponding to bound molecular states, provided the temperature is not too high. Integrals for calculating the first Chapman-Enskog approximation to the coefficients of viscosity, thermal conductivity, and diffusion have been estimated. The auxiliary functions A*, B*, and C*, which are required to calculate the coefficients of viscosity, thermal conductivity, and thermal diffusion in gas mixtures, are also tabulated. There is no simple way of assessing the accuracy of these estimates; however, when the same method is applied to the exponential repulsive potential, the estimated integrals agree with rigorously computed values to within 5% or better. (auth)

26754 TWO-FLUID MODEL FOR THE STRUCTURE OF NEUTRAL SHOCK WAVES. S. Ziering, F. Ek, and P. Koch (Allied Research Associates, Inc., Boston). Phys. Fluids, 4: 975-87(Aug. 1961).

Recent measurements indicate that the thickness of weak and moderate strength shocks (M < 2) is given accurately by the Navier-Stokes equations, whereas there is good reason to believe that the bimodal theory of Mott-Smith is a better description for strong shocks. It is therefore desirable to develop a theory that can account for shock structure at both large and small Mach number. Results of a promising two-fluid theory by Glansdorff are recomputed and the formulation is criticized. A modified two-fluid approach is developed, employing moments of the respective Boltzmann equations for each fluid, and employing an intermediate Maxwellian distribution function with a mean flow velocity and temperature at the center of the shock to account for irreversible particle transfer between the two fluids. Numerical solutions for rigid-sphere and inverse fifth molecules are given, and comparisons with other solutions and experimental data are made. The results are in substantial agreement with requirements at both large and small Mach number. (auth)

26755 TRANSIENT MAGNETOHYDRODYNAMIC DUCT FLOW. T. S. Lundgren, B. H. Atabek, and C. C. Chang (Univ. of Minnesota, Minneapolis). Phys. Fluids, 4: 1006-11(Aug. 1961).

Parallel flow of an electrically conducting viscous incompressible fluid in a rectangular duct with transverse magnetic field is considered. The walls of the duct which are parallel and perpendicular to the imposed magnetic field are taken to be nonconducting and perfectly conducting, respectively. Assuming the fluid to be at rest at the initial moment, exact solutions for the velocity and magnetic field components are obtained in the form of convolution integrals taking the longitudinal pressure gradient as an arbitrary given function of time. Later, taking a step function for the pressure gradient, these expressions are integrated. For this case, the effect of the strength of the imposed magnetic field on the development behavior of the flow is studied. It is found that except for very large magnetic fields, the flows are over damped. (auth)

26756 LOW-FREQUENCY OSCILLATIONS IN CESIUM THERMIONIC CONVERTERS. N. D'Angelo (Princeton Univ., N. J.). Phys. Fluids, 4: 1054-5(Aug. 1961). (MATT-73)

Oscillations with frequencies in the 100 kc range were observed in the operation of cesium converters for cathodes at 1350 to 1450°K. The frequencies correspond roughly to those of ion-plasma oscillations and a positive ion sheath may be present near the cathode. (L.N.N.)

26757 THEORY OF ZEEMAN EFFECT IN THE GROUND MULTIPLETS OF RARE-EARTH ATOMS. B. R. Judd and I. Lindgren (Univ. of California, Berkeley). Phys. Rev., 122: 1802-12(June 15, 1961). (UCRL-9188)

A number of corrections are made to the simple Landé formula for the g values of levels deriving from the ground term of configurations of the type $4f^n$. These include: (a) the Schwinger correction, to give an accurate value of the gyromagnetic ratio for the electron spin; (b) a correction to allow for the deviations from perfect RS coupling; (c) a relativistic correction, which is directly related to the kinetic energy of the electrons; (d) a diamagnetic correction, depending on the electron density of the core. In order to calculate (b), the spin-orbit coupling constants and the Coulomb integrals F_k are estimated either from existing spectroscopic data or from a process of interpolation or extrapolation. An argument is presented for taking ratios of the integrals F_k corresponding to a hydrogenic eigenfunc-

tion. The various radial integrals required in the calculation of (c) and (d) are derived from a modified hydrogenic eigenfunction of the form $r^n e^{-ar} \cosh[\kappa(ar-n)]$. The parameter κ in this expression is estimated to be approximately 0.42 over the rare earth series by comparison with available Hartree self-consistent field eigenfunctions. The second parameter a is chosen to give a fit with the spin-orbit coupling constants. The result of calculating (a), (b), (c), and (d) is to give atomic g values which agree remarkably well with the experimental data. This confirms that the ground configurations of PrI, NdI, PmI, SmI, EuI, DyI, HoI, ErI, and TmI are of the type $4f^n$, and that such a configuration is very low-lying in TbI. Tables of spin-orbit coupling constants and (r^{-3}) for both neutral and triply ionized rare earth atoms are given as well as of other radial integrals. (auth)

26758 COMPARISON OF TWO THEORETICAL APPROACHES TO ELECTRON BEHAVIOR IN Ar–CO_2, Ar–N_2, Ar–H_2, AND Ar–CO GAS MIXTURES. Martin A. Uman (Univ. of Arizona, Tucson). Phys. Rev., 123: 399-403(July 15, 1961).

The electron drift velocity and electron average energy for low-energy electrons in binary gas mixtures of Ar-CO_2, Ar-N_2, Ar-H_2, and Ar-CO were determined using two theoretical methods of approach: (1) a "distribution function," or "Boltzmann equation" approach; and (2) an "average electron" approach. The results of the two theoretical methods of approach were compared and discussed. (auth)

26759 DIFFUSION OF NEON, HT, AND DEUTERIUM IN LIQUID HYDROGEN. G. Cini-Castagnoli (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome), A. Giardini-Guidoni, and F. P. Ricci. Phys. Rev., 123: 404-6(July 15, 1961).

Experimental results about diffusion of Ne, HT, and D_2 in liquid H_2 are reported and analyzed with the corresponding states principle. The features of the quantum deviations are indicated. (auth)

26760 SINGLE-CRYSTAL AND POLYCRYSTAL RESISTIVITY RELATIONSHIPS FOR YTTRIUM. J. K. Alstad, R. V. Colvin, and S. Legvold (Ames Lab., Ames, Iowa). Phys. Rev., 123: 418-19(July 15, 1961). (IS-256)

Different proposals for calculating polycrystal resistivities from single-crystal values were applied to yttrium metal. It is shown that a simple average yielding $\rho_{poly} = \frac{1}{3}(2\rho_\perp + \rho_\parallel)$ gave the best fit to experimental data. (auth)

26761 STUDY ON THE SUPERCONDUCTING TRANSITION TEMPERATURE IN DILUTE THALLIUM SOLID SOLUTIONS. D. J. Quinn and J. I. Budnick (IBM Research Lab., Poughkeepsie, N. Y.). Phys. Rev., 123: 466-9(July 15, 1961).

The superconducting transition temperature, T_c, has been measured for dilute solid solutions of indium, bismuth, and lead in thallium. The transition temperature is found to increase in all cases thus exhibiting a behavior opposite to that observed by Serin, Lynton, and co-workers in their studies of solid solutions of tin, indium, and aluminum. Some loss in residual impurity scattering which occurs upon annealing suggests the migration of solute atoms to grain boundaries in the dilute alloys. (auth)

26762 INDIRECT EXCHANGE MODEL FOR FERROMAGNETIC METALS. S. H. Liu (IBM Corp., Yorktown Heights, N. Y.). Phys. Rev., 123: 470-4(July 15, 1961).

The ferromagnetic properties of rare-earth metals and their alloys are discussed in terms of the indirect exchange model. It is shown by the molecular-field approximation that, in calculating the Curie temperatures of these metals, the simple theory of Fröhlich and Nabarro and Zener is applicable. The second-order energy terms calculated by Ruderman and Kittel, Kasuya, and Yosida are important in discussing the low-temperature properties. Some numerical results are obtained which are in good agreement with the experiments. (auth)

26763 ANALYTIC HARTREE-FOCK WAVE FUNCTIONS FOR THE 3 p-SHELL ATOMS. R. E. Watson (Avco Mfg. Corp., Wilmington, Mass.) and A. J. Freeman. Phys. Rev., 123: 521-6(July 15, 1961).

Hartree-Fock wave functions have been obtained for the 3p-row atoms, i.e., for neutral, Al, Si, P, S, Cl, and Ar, and for Cl^-. Solutions were determined in analytic form using a version of Nesbet's symmetry and equivalence restrictions to simplify the calculations for atoms with both closed and unclosed shells of the same l value. These restrictions, the reason for their use, and their relation to other open-shell methods are discussed and the calculated one-electron wave functions and their eigenvalues are presented. (auth)

26764 ATOMIC BEAM RESONANCE EXPERIMENTS WITH STORED BEAMS. H. Mark Goldenberg, Daniel Kleppner, and Norman F. Ramsey (Harvard Univ., Cambridge, Mass.). Phys. Rev., 123: 530-7(July 15, 1961).

The atomic-beam separated, oscillatory-field resonance technique has been used to study the hyperfine frequency of cesium which is perturbed by collisions with storage box walls. With a wall coating of long straight-chain saturated hydrocarbons, resonances are observed after as many as 200 wall collisions. A theory of the effect of wall collisions on the hyperfine frequency which is in qualitative agreement with experimental results is described. The shape of the resonance curve is analyzed by a detailed consideration of the statistical nature of the wall collision. (auth)

26765 STATISTICAL ELECTRON DENSITY DISTRIBUTIONS AND THOMAS-FERMI-DIRAC SCREENING FUNCTIONS FOR NEUTRAL ATOMS. Adolf A. Abrahamson (City Coll., New York and Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 538-43(July 15, 1961). (BNL-5298)

Statistical electron density distributions and Thomas-Fermi-Dirac (TFD) screening functions have been obtained for the 104 elements corresponding to integral atomic numbers Z = 2 to Z = 105, for 117 values of radial distance from the atomic center in each case. These results were calculated, in part, by using Thomas' solutions of the TFD equation in terms of the statistical electron distributions for nonintegral values of Z and Jensen's boundary conditions. Values for argon and copper are given here. The complete set of tables for all 104 elements has been deposited with the American Documentation Institute Auxiliary Publications Project. (auth)

26766 CESIUM TRANSITION PROBABILITIES FOR OPTICAL PUMPING. W. Bruce Hawkins (Oberlin Coll., Ohio). Phys. Rev., 123: 544-7(July 15, 1961).

Optical transition probabilities are presented between the several magnetic sublevels of the Cs^{133} ground state via the first excited state, given separately for the two fine-structure components. Graphs of the populations of representative states are presented as a function of the time the atoms are illuminated, and a table is given of the populations of atoms absorbing integral numbers of photons from both D lines simultaneously, both polarized and unpolarized. (auth)

26767 OPTIMAL MEASURING APPARATUS. Mutsuo M. Yanase (Princeton Univ., N. J.). Phys. Rev., 123: 666-8(July 15, 1961).

An upper limit for the accuracy of the measurement of a simple quantity which does not commute with a conserved quantity is obtained in terms of the "size" of the apparatus. The "size" of the apparatus is defined as the mean square value $\hbar^2M^2$ of the conserved quantity for the apparatus which is, in the example chosen, the z component of the angular momentum. The measured quantity is the projection of a spin in a perpendicular direction. It is found that the probability of an unsuccessful measurement is at least $\frac{1}{8}M^2$. (auth)

26768 ION MOTION IN SUPERFLUID LIQUID HELIUM UNDER PRESSURE. Lothar Meyer (Univ. of Chicago) and F. Rief. Phys. Rev., 123: 727-31(Aug. 1, 1961).

Recent investigations of superfluidity by a study of the mobilities of ions in liquid He(II) are extended to the liquid under pressure. At a fixed temperature the positive-ion mobility decreases appreciably as the pressure is increased, particularly at low temperatures. At a fixed pressure the mobility increases less rapidly with decreasing temperature at higher pressures. The negative-ion mobility, smaller than that of the positive ion at zero pressure, becomes equal to that of the latter above 7 atm. In high electric fields and at high pressures, the drift velocity of the negative ions approaches a limiting value roughly equal to the Landau critical velocity for a body moving through the superfluid. The theory, which discusses the mobility in terms of ion scattering by rotons and phonons, is reviewed. It is pointed out that previously neglected effects concerned with the importance of small-angle scattering of the ion ought to be taken into account; some earlier estimates of scattering cross sections are revised accordingly. It is then shown that this theory, making use only of the known change of the roton dispersion relation with pressure, can account quantitatively for the observed pressure dependence of the positive-ion mobilities. (auth)

26769 EFFECT OF HYDROSTATIC PRESSURE ON IONIC CONDUCTIVITY IN DOPED SINGLE CRYSTALS OF SODIUM CHLORIDE, POTASSIUM CHLORIDE, AND RUBIDIUM CHLORIDE. C. Ballard Pierce (Univ. of Illinois, Urbana). Phys. Rev., 123: 744-54(Aug. 1, 1961).

The effect of hydrostatic pressure up to 9000 kg/cm^2 on ionic conductivity in NaCl, KCl, and RbCl single crystals doped with divalent impurities has been studied over the temperature range 200° to 500°C. The conductivity in this temperature range is due almost entirely to the motion of extrinsic cation vacancies. The activation volume ΔV_m for motion of the cation vacancies is 7.7 ± 0.5 cc/mole in NaCl doped with $CaCl_2$ and 7.0 ± 0.5 cc/mole in KCl doped with $SrCl_2$. The results are in fair agreement with values predicted on the basis of Keyes's empirical expression relating activation volume to activation energy and isothermal compressibility. Sample materials were chosen with the view of testing for a correlation between activation energy and shear modulus. The small shear modulus in KCl and RbCl decreases with increasing pressure, while the reverse is true for NaCl. However, the data are not adequate to draw definite conclusions about such a correlation. The conductivity of RbCl doped with $BaCl_2$ increases by an order of magnitude at the phase transition from the NaCl to the CsCl structure. At 300°C, the transition occurs at 6100 kg/cm^2. (auth)

26770 Fe^{57} MÖSSBAUER EFFECT IN Cu–Ni ALLOYS. G. K. Wertheim and J. H. Wernick (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 123: 755-7(Aug. 1, 1961).

The Mössbauer effect of Fe^{57} was used to study the properties of iron impurity atoms in the complete range of composition of Cu-Ni alloys. The isomer shift indicates a small decrease in the total electronic density at the Fe^{57} nucleus in going from pure Ni to pure Cu. The magnetic field at the iron nucleus at 0°K decreases by 9% in the range from 0 to 40% Cu. Both results show that only minor changes take place in the atomic configuration of the iron. The linewidth, measured in the paramagnetic alloys, is smallest in pure copper and largest near the middle of the composition range. The rapid change in linewidth with small nickel admixture can result from quadrupole splitting due to the field gradients arising from the spatial charge fluctuations around an impurity atom. Some of the broadening can also arise from an inhomogeneous isomer shift due to a range of surroundings of an iron atom in the alloy. (auth)

26771 REFLECTION OF NOBLE GAS IONS AT SOLID SURFACES. Homer D. Hagstrum (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 123: 758-65(Aug. 1, 1961).

A method was developed for distinguishing the reflection of ions at solid surfaces as ions or as metastable atoms. Results are given for He^+, Ne^+, and Ar^+ ions incident on clean W, Mo, and Si(100) and on contaminated W, Hf, and Ge(111) surfaces. The reflection coefficient of ions to ions (R_{ii}) is found to be small (0.0004 to 0.002) and essentially independent of incident ion energy. The reflection coefficient of ions to metastable atoms (R_{im}) is found to increase with ion energy from values comparable to R_{ii} at 10 ev to values as high as 0.04 to 1000 ev. Discussion of these results is given in terms of the known resonance and Auger transitions which can occur near a solid surface for ions of sufficiently large ionization energy. It is shown that the results can be accounted for only if ions are transformed to metastable atoms very close to the surface, and a possible mechanism for this process is proposed. (auth)

26772 FLUORESCENCE AND OPTICAL MASER EFFECTS IN $CaF_2:Sm^{++}$. W. Kaiser, C. G. B. Garrett, and D. L. Wood (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Rev., 123: 766-76(Aug. 1, 1961).

Measurements are reported of absorption, emission, and activation spectra in $CaF_2:Sm^{2+}$, and also of fluorescence lifetime. A revised level scheme is proposed. Observations of optical maser effects were made at liquid hydrogen and liquid helium temperatures over a wide range of pumping intensities. For illumination in the 6400-A band, the threshold intensity of illumination was about 20 w cm^{-2}. Observations are reported of the dependence of the intensity of the maser beam on the pumping intensity. Photographic observations, made both with or without a Fabry-Perot etalon, show that on one particular sample five distinct frequencies were present in the maser signal, and that the number of modes excited was of the order of 1000. (auth)

26773 LATTICE DISTORTION DUE TO ISOTOPES IN SOLID HELIUM. P. G. Klemens and A. A. Maradudin (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 123: 804-6(Aug. 1, 1961).

Observations of the thermal resistivity of solid helium containing He^3 isotopes indicated that the phonon scattering cross section of the isotope is three times larger than the theoretical value obtained by considering only the mass-difference. Using as a model a helium atom in the potential well formed by its neighbors, and taking account of the zero-point energy of that atom and of the strain energy in the surrounding solid when the atomic cell is expanded, it is shown that around a He^3 isotope the lattice suffers an outward distortion of about 1–2%. This distortion can account for the discrepancy in the phonon scattering cross section. (auth)

26774 MAGNETIC MOMENT OF LANTHANUM MAGNETOPLUMBITE FERRITE. A. Aharoni and M. Schieber

(Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev., 123: 807-9(Aug. 1, 1961).

The composition $La^{3+}Fe^{2+}Fe^{3+}_{11}O_{19}$ was prepared by sintering the oxides, and its magnetic moment was measured from liquid air temperature to the Curie point. At the lowest temperature a value of 17.5 Bohr magnetons per formula weight was obtained, as compared with 19 Bohr magnetons of $BaFe^{3+}_{12}O_{19}$. The difference is qualitatively understood if the Fe^{2+} ion is a nearest neighbor to the La^{3+} in the crystal, i.e., in the [12K] site, thus decreasing the total magnetic moment. The Curie temperature is 695°K, compared to 725°K of $BaFe^{3+}_{12}O_{19}$. The lower Curie point can again be qualitatively explained by less exchange interaction with the divalent iron of $LaFe^{2+}Fe^{3+}_{11}O_{19}$, or possibly by the change in unit cell dimension which modifies the short-range exchange interaction between the iron ions. (auth)

26775 MAGNETIC PROPERTIES OF $HCrO_2$ AND $DCrO_2$. R. G. Meisenheimer and J. D. Swalen (Shell Development Co., Emeryville, Calif.). Phys. Rev., 123: 831-4(Aug. 1, 1961).

Magnetic susceptibility measurements and electron paramagnetic resonance measurements were made on powdered chromous acid ($HCrO_2$) and deuterated chromous acid ($DCrO_2$). The Curie constants, derived from the susceptibility results, are consistent with three unpaired electrons associated with each chromium ion. In addition, a large Curie-Weiss θ temperature, indicating a strong exchange interaction, is necessary to account for the results. The most unusual feature of this particular exchange is that it is strongly influenced by deuteration. The electron paramagnetic resonance spectra also show strongly exchange-narrowed lines with a variation between $HCrO_2$ and $DCrO_2$. From a comparison between the calculated and observed linewidths and second moments, a value of the zero-field splitting is estimated. Although no transition has been observed to an antiferromagnetic state, the Curie-Weiss θ temperatures indicate that the ground state is undoubtedly antiferromagnetic for both $HCrO_2$ and $DCrO_2$. Superexchange through the intervening proton or deuteron is probably the main source of any antiferromagnetic exchange coupling. Some of the various mechanisms proposed for superexchange are discussed in relation to chromous acid. (auth)

26776 THEORY OF RESONANCE ABSORPTION OF ENERGY BY A ROTATING SOLID. Joseph Dreitlein (Univ. of Pennsylvania, Philadelphia) and Horst Kessemeier. Phys. Rev., 123: 835-52(Aug. 1, 1961).

The theory of both nuclear resonance energy absorption and the relaxation of a coherent magnetization transverse to an applied external magnetic field is developed for nuclei in a mechanically rotating solid. The consequences of the formalism in the simple case of a solid composed of effectively isolated nuclear pairs is presented. For the more general nuclear lattice, a procedure for isolating and experimentally measuring the "exchange" interaction between the nuclei in the solid is proposed. Finally, the moments of the energy absorption line shape for the rotating solid are investigated and the second and fourth moments are explicitly calculated. (auth)

26777 ELECTRON ENERGY DISTRIBUTIONS IN PLASMAS. III. THE CATHODE REGIONS IN HELIUM, NEON AND ARGON. N. D. Twiddy (University Coll., London). Proc. Roy. Soc. (London), A262: 379-94(July 18, 1961).

The Druyvesteyn method of measuring electron energy distributions in low-pressure plasmas was applied to the cathode region of hot discharges in helium, neon, and argon at a pressure of 0.05 mm Hg; in all cases the column was striated. In helium and neon, measurements in the striation nearest the cathode showed two well separated groups of electrons, the more energetic from the Langmuir sheath at the filament; the lower-energy group being produced by the primary electrons in inelastic collisions. At higher currents, the trough between the two groups tended to be eliminated. In the negative regions in argon, the uniform field augmented the energy of the electrons without modifying the broad features of the distribution. (L.N.N.)

26778 ORDERING TRANSITIONS IN SYMMETRICAL MOLECULES. Edgar F. Westrum, Jr. (Univ. of Michigan, Ann Arbor). Pure and Appl. Chem., 2: 241-9(1961).

The transitions occurring in the compounds $C(CH_2X)_4$; where X is OH, F, Cl, Br, or I; and in adamantane are studied in relation to their low temperature thermodynamic properties. The transitions which result from an orientation of the molecule within the crystal structure are described as being pseudo-rotational. Consequently, in the pseudo-rotational transitions, the entropy associated with the change occurring in the symmetry features of the structures, both molecular and crystallographic, should be in agreement with the entropy calculated statistically from the change in the number of symmetry features involved in the transitions. This hypothesis is discussed in terms of experimental results. A comparison of these transitions with the transitions in neopentane is also presented. (N.W.R.)

26779 TIME-AVERAGED EFFECTS ON CHARGED PARTICLES IN A-C FIELDS. T. W. Johnston (RCA Victor Co., Ltd., Montreal). RCA Rev., 21: 570-610(Dec. 1960).

When a nonuniform a-c field is applied to a charged particle it experiences a time-averaged acceleration in addition to the a-c acceleration. The development and application of the basic theory to plasmas are outlined, including some cases with a d-c magnetic field. A bibliography and a critique of theory and experiments are also given. (auth)

26780 THE FERROELECTRIC BEHAVIOUR OF SOME NEW NIOBATE COMPOUNDS AND THEIR APPLICATION TO PIEZOELECTRIC DEVICES. B. Lewis and L. A. Thomas (General Electric Co. Ltd., Wembley, Eng.). Solid State Phys. Electronics Telecommuns., Proc. Intern. Conf. Brussels, 1958, 883-90(1960).

Ferroelectric properties of cadmium, lead, lead-barium, potassium, silver, sodium, and sodium-cadmium niobates are given along with barium titanate ferroelectric properties for comparison. Results show that cadmium, potassium, silver, and sodium niobates have poor piezoelectric activity and cannot be used as piezoelectric material, however the properties can be changed by adding cadmium to the sodium niobate with the result of improved piezoelectric properties. Lead and lead-barium niobates have reasonably high piezoelectric activity and lead metaniobate has the highest known Curie temperature (570°C). (N.W.R.)

26781 THE DETERMINATION OF THE SPIN POLARIZATION FROM TRANSPARENCY CHANGES IN THE OPTICAL PUMP WITH THE SODIUM D_1 LINE. H. Boersch, W. Raith, and M. Rehmet (Technische Universität, Berlin). Z. Physik, 163: 197-206(1961). (In German)

A Dehmelt type experiment is performed in which sodium vapor and argon as a buffer are employed. The pumping radiation consists of the circularly polarized D_1 line. Since the strongly absorbing magnetic sublevels are depopulated, the vapor becomes more transparent to the pumping radiation with growing polarization. The transparency of the vapor is measured with and without optical pumping as a

function of the sodium vapor density. The degree of polarization is determined in simulating the increase in transparency due to polarization by decreasing the sodium vapor density of the unpumped sample. This method requires the knowledge of the exact sodium vapor density in the temperature range of interest (100 to 200°C). The determination of the degree of polarization is based on the assumption that the atomic absorption cross section Q, which depends on the degree of polarization P and the frequency of light v, can be written in the form $Q(P,v) = A(P) \cdot B(v)$, where A(P) is a linear function of P, while B(v) must not be changed by optical pumping. As will be shown in a following paper, the degree of polarization determined under this assumption, describes in good approximation the polarization of the sodium valence electrons. (auth)

26782 INFRARED, PART I: GENERAL RESEARCH, EQUIPMENT AND MATERIALS. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). May 1961. 13p. (SB-466)

Included are 213 references to Publication Board reports, translations, and AEC reports added to the OTS collection during the period 1950 to June 1961. References are given to 7 patents also. (P.C.H.)

26783 PREPARATION ET ETALONNAGE DES SOURCES RADIOACTIVES DE REFERENCE. (Preparation and Standardization of Radioactive Reference Sources). "Review Series—Monograph Collection No. 14" of the International Atomic Energy Agency, Vienna. A Gandy (Foundation Curie). 1961. 101p. $1.00(IAEA). (STI/PUB/15/14)

After defining what is meant by radioactive reference sources, the requirements that these sources must satisfy are described in order that a method may be determined for their preparation. Then the characteristics of various sources are given. Several methods of standardizing are given. 4π-g counting and beta-gamma coincidence are discussed in detail, while less important methods are merely summarized. The relative measuring methods which make it possible to calibrate one source by reference to another, the value of which is already determined by some absolute method, are also given. The principles involved in the standardization of neutron sources are described. The precautions which have to be taken when using reference sources in order to obtain accurate results are reviewed. (N.W.R.)

26784 MATTER AND ANTIMATTER. Maurice Duquesne. Science Today Series. Translated by A. J. Pomerans from "Matiere et Antimatiere." New York, Harper & Brothers, 1960. 127p.

Elementary atomic theory and relativity are discussed briefly. Experimental production of antinucleons is discussed, as well as the discovery of positrons. Other antiparticles are mentioned. The possibility of the existence of antiatoms and the difficulties encountered in their experimental production are discussed, as well as further speculations on antimatter characteristics. (L.N.N.)

Astrophysics and Cosmology

26785 (NASA-TN-D-1065) TECHNICAL NOTE ON THE ELECTRON DENSITY DISTRIBUTION ABOVE THE F2 PEAK. S. J. Bauer (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). July 1961. 6p.

The distribution of free electrons in an isothermal upper ionosphere consisting of a binary ion mixture (O^+ and H^+) is discussed. It is shown that for diffusive equilibrium, which should prevail at altitudes well above the F2 peak, measurements of the electron density distribution permit the determination of other structural parameters of the upper atmosphere, such as the temperature and the concentration of oxygen ions and protons. (auth)

26786 (NP-9479) ASTRONAUTICS INFORMATION; OPEN LITERATURE SURVEY. VOLUME II. NO. 10 (Entries 22,871—23,094). (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Oct. 1960. Contract NASw-6. 73p.

An open literature survey on astronautics is presented which covers the period of Oct. 1960. The material is organized alphabetically according to subject. A list of periodicals scanned is given in volume II No. 1-2 with addendums in subsequent volumes. Cumulative author and subject indexes are given at the end of the entries. (About 220 references.) (J.R.D.)

26787 (NRL-5608) NAVAL RESEARCH LABORATORY PAPERS PRESENTED AT THE TENTH INTERNATIONAL ASTROPHYSICAL SYMPOSIUM, LIEGE, BELGIUM—JULY 11-15, 1960. (Naval Research Lab., Washington, D. C.). July 21, 1961. 57p.

The Tenth International Astrophysical Symposium was held at the Institute of Astrophysics, University of Liege, Belgium, from July 11 to 15, 1960. The subject of the symposium was "Stellar Spectra in the Far Ultraviolet." Naval Research Laboratory scientists presented nine papers, of which two were introductory surveys of NRL work in the astrophysical field. NRL equipment and plans were reviewed, as were those of the National Aeronautics and Space Administration, the USSR, Britain, France, and Italy. The history of solar observations in the ultraviolet and x-ray wavelength regions was also reviewed. Original research in stellar and solar observations in the ultraviolet and x-ray spectral regions was reported including the solar eclipse expedition of October 12, 1958; Lyman-α and ultraviolet observations of the night sky; and solar observations of extreme ultraviolet, Lyman-α, and x-ray radiation including Lyman-α and x-ray photography. (auth)

26788 THE DETERMINATION OF POTASSIUM IN METEORITES BY THE K/Ar METHOD. Daniel Krummenacher (Université, Geneva). Helv. Chim. Acta, 44: 1054-7(1961). (In French)

Some indications are given about isotopic dilution analysis of meteoritic K and the contamination by K of the reagents used for it. The K/A ages of the Richardton and Murray meteorites are found to be 4.59 and 2.51×10^9 years, respectively. (auth)

26789 EFFECTS OF CORPUSCULAR EMISSIONS ON THE POLAR IONOSPHERE FOLLOWING SOLAR FLARES. G. E. Hill (Avco Corp., Wilmington, Mass.). J. Geophys. Research, 66: 2329-35(Aug. 1961).

The morphology of two polar absorption events, July 24-25 and September 18-22, 1957, representing different types of ionospheric disturbances, is presented. It was found that in both events the absorption was more intense in the sunlit portion of the polar cap than in the darkened portion by several megacycles, and that following the polar cap absorption event (PCA) of the September storm, strong auroral zone absorption occurred, a geomagnetic storm developed, and the F_2 layer critical frequency decreased markedly, whereas following the July PCA none of these additional disturbances appeared. (auth)

26790 SIZE AND MASS DISTRIBUTION OF COSMIC DUST. Taivo Laevastu (Fisheries Div., FAO, Rome) and Otto Mellis. J. Geophys. Research, 66: 2507-8(Aug. 1961).

The size distribution of the cosmic spherules found in sediments shows that the total mass of particles in equal size (diameter) intervals remains constant. The size distribution of cosmic dust in space, as computed from the data obtained by impact measurements by artificial satellites, shows the same distribution in the interval of particle diameters approximately 5 μ and 15 μ, and as determined by indirect extrapolation the distribution is probably valid for larger particles. (auth)

26791 ANNIHILATION PROCESS OF NEUTRINO PRODUCTION IN STARS. H. Y. Chiu (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 123: 1040-50 (Aug. 1, 1961).

The rate at which the energy of a blackbody radiation is converted into neutrinos by the pair annihilation process $e^- + e^+ \rightarrow \nu + \bar{\nu}$ has been calculated. At $T \sim 6 \times 10^9$ °K the relaxation time for such conversion process is around 100 sec for pure radiation. Since neutrinos have a very long mean free path (≫ stellar dimensions) they will escape, thus carrying away the energy. This process therefore will be of astrophysical importance. The rate of energy loss dU/dt is tabulated, as a function of temperature and density, together with the chemical potential, the pressure, and the electron-positron energy. This table should be useful for numerical integrations of stellar structure equations in the temperature range (0.5 to 10) × 10^9 °K, and the density range 0 to 10^9 g/cm^3. (auth)

Cosmic Radiation

26792 (NP-10301) INTERNATIONAL WORKING MEETING ON COSMIC RAYS, BUCHAREST, MAY 8–14, 1959. (Academia R.P.R. Institutul de Fizca Atomica, Bucharest). 1960. 236p.

Studies of high and low energy interactions of cosmic mesons, nucleons, and nuclei with emulsion nuclei and nucleons are reported. The properties of jets, stars, and combinations of these two are examined. Interaction models are reviewed. The absorption of cosmic radiation by lead, air, and earth is investigated. Thirty-three papers were presented at the conference. Twenty-one papers and twelve abstracts of papers are included, five of which are in Russian and one in French. Separate abstracts are prepared for sixteen of the papers. The remaining five papers were previously abstracted in NSA. (T.F.H.)

26793 (NP-10301(p.20-7)) THE TWO CENTER-MODEL OF HIGH ENERGY INTERACTIONS. M. Miesowicz.

The two-center model for high-energy interactions between nucleons and nuclei is discussed. The physical interpretation of this model as emission by two excited nucleons, "fireball" emission, or emission influenced by nucleon structure effects is reviewed. (T.F.H.)

26794 (NP-10301(p.32-43)) HIGH–ENERGY NUCLEAR INTERACTIONS OF HEAVY PRIMARY NUCLEI IN EMULSIONS. E. Balea, E. Friedländer, M. Oncescu, C. Potoceanu, and M. Sahini (Academia R.P.R. Institutul de Fizca Atomica, Burcharest).

Jets from high-energy interactions between heavy primary cosmic nuclei and emulsion nuclei are considered. Evaporation and meson production are studied, and the effects of structure are outlined. The two-center model is applied to the analysis of the interaction. (T.F.H.)

26795 (NP-10301(p.54-9)) ON THE AZIMUTHAL DISTRIBUTION OF MESON JETS. E. Balea, E. Friedlander, M. Oncescu, C. Potoceanu, and M. Sahini (Academia R.P.R. Institutul de Fizca Atomica, Bucharest).

The interactions of nucleons in nuclei with cosmic protons and heavy primary cosmic nuclei are studied. The azimuthal distributions of meson jets from these interactions are explained in terms of the two-center model of the collision. The nucleon-proton interactions have a nonuniform distribution, as expected on the basis of the two-center model; but the nucleon-nucleus interactions have a uniform distribution, within the statistical accuracy of the data. (T.F.H.)

26796 (NP-10301(p.62-8)) ON ENERGY TRANSFER IN COSMIC-RAY JETS. E. M. Friedländer (Academia R.P.R. Institutul de Fizca Atomica, Bucharest).

The interactions between cosmic nucleons and emulsion nuclei are studied at high energies. A method is presented for determining whether the bulk of the primary energy is transferred to a single nucleon or to several nucleons in the nucleus. (T.F.H.)

26797 (NP-10301(p.69-75)) ON ONE CONSEQUENCE OF THE CONSTANCY OF TRANSVERSE MOMENTA IN COSMIC-RAY JETS. E. M. Friedländer (Academia R.P.R. Institutul de Fizca Atomica, Bucharest).

A test is presented for the hypothesis that the transverse momenta p_0 of secondaries from cosmic particle jets are all equal. A relation is found between the Lorentz factor γ and the angular distributions of the jets, under the assumption of constant p_0. These γ values are compared to the γ values found without this assumption, for jets with energies of 10 to 10^4 Bev. (T.F.H.)

26798 (NP-10301(p.76-107)) MEKHANIZM VZAIMODEISTVIYA BYSTRYKH PROTONOV S NUKLONAMI I YADRAMI. (Interaction Mechanism of Fast Protons with Nucleons and Nuclei.) V. S. Barashenkov, V. A. Belyakov, Shu-fen Wang, V. V. Glagolov, N. Dalkhazhav, L. F. Kirilova, R. M. Lebedev, V. M. Mal'tsev, P. K. Markov, K. D. Tolstov, E. N. Tsiganov, M. G. Shaffanova, and Ch'ing-hsieh K'uo.

The mechanism of 9-Bev proton interactions with photoemulsion nuclei was studied with a pile of 10 × 10 cm^2 and 450μ thick photoemulsion layers irradiated by 9-Bev proton beam in a synchrotron. Data are presented on the observed loss of energy, on the generation of slow strange particles, and on other aspects of proton-nucleus interactions. (R.V.J.)

26799 (NP-10301(p.130-44)) ON ANGULAR CORRELATIONS IN $\pi - \mu - e$ DECAY. H. Hulubei, J. Ausländer, S. Titeica, and E. Friedländer [Academia R.P.R. Institutul de Fizca Atomica, Bucharest].

Angular correlations in the decay chain $\pi \rightarrow \mu \rightarrow e$ are studied in emulsion, using area and track scanning techniques. The π mesons have an initial energy of ~300 Mev. About 13,800 events are followed. (T.F.H.)

26800 (NP-10301(p.150-4)) MEASUREMENT OF THE ABSORPTION LENGTH OF PENETRATING SHOWER PRODUCING COSMIC-RAY PARTICLES IN AIR. O. Balea, G. Bozoki, E. Fenyves, E. Friedländer, I. X. Ion, and T. Sandor (Magyar Tudományos Akadémia Központi Fizikai Kutató Intézete, Budapest and Academia R.P.R. Institutul de Fizca Atomica, Bucharest).

An experiment is described in which the cosmic μ meson background activity is measured as a function of atmospheric depth and underground depth. The measurement of this background enables the absorption length of penetrating-shower-producing cosmic particles to be determined as 116 ± 6 g/cm^2 of air. (T.F.H.)

26801 (NP-10301(p.155-67)) INTERACTION MEAN FREE PATH OF HEAVY PRIMARY NUCLEI IN EMULSIONS.

E. Friedländer and M. Spirchez (Academia R.P.R. Institutul de Fizca Atomica, Bucharest).

The interaction mean free paths (m.f.p.) of heavy ($Z \geq 3$) primary and secondary cosmic radiations are studied. A statistical investigation of emulsion nuclei evaporations, jets, and combined evaporations and jets is conducted. The heavy secondary m.f.p. is found to be anomalously low. No anomaly is found for the heavy primaries. (T.F.H.)

26802 (NP-10301(p.168-70)) TRANSITION EFFECT OF THE LOW ENERGY N-COMPONENT OF COSMIC RAYS IN LEAD. C. Bercea (Academia R.P.R. Institutul de Fizca Atomica, Bucharest).

The absorption lengths of the low energy N-component of cosmic radiation are measured in lead up to 1 m thick and in air. An absorption anomaly is found in the lead, with a maximum at about 500 g/cm^2 of lead. The N-component is absorbed more strongly in air than in lead, which indicates that a part of the N-component is unstable. This unstable component is tentatively identified as pions. (T.F.H.)

26803 (NP-10301(p.174-88)) INTERACTIONS OF 9 GEV PROTONS IN EMULSION. G. Bozoki, E. Fenyves, Eva Gombosi, and P. Suranyi (Magyar Tudományos Akadémia Központi Fizikai Kutató Intézete, Budapest).

The interactions of 9 Bev protons on emulsion nuclei are studied. The types, mean numbers, and angular and energy distributions of shower particles produced; the mean number of nucleons struck inside the nucleus; and the mean value of the inelasticity coefficient are calculated. (T.F.H.)

26804 (NP-10301(p.196-200)) ON THE BEHAVIOR OF THE SOFT COMPONENT OF COSMIC RADIATION UNDER LEAD LAYERS. O. Balea and E. Friedländer (Academia R.P.R. Institutul de Fizca Atomica, Bucharest).

The soft component of cosmic radiation passes through a thick-lead upper shield and a variable-thickness lower lead shield, and its intensity is measured after passing through both. The intensity is observed to increase as the separation between the shields increases. An experiment is conducted to determine whether this effect is caused by production of neutral unstable particles between the shields, side effects, or variations in the acceptance solid angle of the counter. (T.F.H.)

26805 (NP-10301(p.201-2)) VYSOKOGORNAYA STANTSIYA PO ISSLEDOVANII KOSMICHESKIKH LUCHEI NA GORE RILA (BOLGARIYA). (Report of the High-Altitude Laboratory at Rila). B. Betev.

Descriptions are given of a high-altitude laboratory built on the top of Mt. Rila on Balkan peninsula at the elevation of 2925 m. The laboratory is equipped for detecting and measuring wide atmospheric showers, cosmic radiation intensities, and penetrating components of cosmic rays. (R.V.J.)

26806 (NP-10301(p.203-6)) A FAST METHOD FOR THE MEASUREMENT OF THE EFFICIENCY OF G M-COUNTERS. E. Fenyves and A. Somogyi (Magyar Tudományos Akadémia Központi Fizikai Kutató Intézete, Budapest.)

A method is described for rapid measurement of G-M counter efficiencies (E) above 99%. The counter in question is connected in anticoincidence with several other G-M counters for which $E \approx 99.9\%$, and the desired E is found from the number of anticoincidences as compared to the total number of counts. Using dead-time reducing circuits and other specialized apparatus, E may be found with an accuracy of ~0.1% in about 1.5 hr. (T.F.H.)

26807 (NP-10301(p.219-24)) HIGH ENERGY PION-NUCLEON SCATTERING AND NUCLEON STRUCTURE. G. Domokos (Magyar Tudományos Akadémia Központi Fizikai Kutató Intézete, Budapest).

A covariant diffraction approximation is developed for relativistic elastic pion-nucleon interactions. The nucleon is found to behave as an absorptive medium with an adjustable spectral function F(k), where k is the incident pion four-momentum. The example is given of π^--p scattering at 5 Bev. In this case, F(k) can be adequately represented by a Gaussian function. (T.F.H.)

26808 (NP-10301(p.225-30)) ON THE ANALYSIS OF THE ANGULAR PART OF THE S-MATRIX IN INELASTIC COLLISIONS. Jan Fischer and Seria Ciulli (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.).

A method is described by which the channel operators appearing in the angular part of the scattering matrix may be found for complex inelastic interactions. The operators are found by expanding the operators of simple processes, whose properties are known, in Legendre polynomials. The Clebsch-Gordan summations are thus avoided. (T.F.H.)

26809 (NASA-TT-F-67) VARIATIONS OF COSMIC RAY INTENSITY. Yu. G. Shafer, ed. Translated Trudy Yakutsk. Filiala Akad. Nauk S.S.S.R., No. 3, 1960. 128p.

The results of experimental and theoretical research carried out during the International Geophysical year are reviewed. The first section describes single-model automatic counter installations used to measure the frequency of extensive atmospheric showers and cosmic rays below ground, and apparatus which records the intensity aboard artificial earth satellites. The second section deals with analysis of the role played by meteorological factors in cosmic-ray variations. The third section describes experimental and theoretical investigations of extra-atmospheric cosmic-ray variations. (M.C.G.)

26810 PREDICTIONS OF COSMIC RAY STORMS FROM GEOMAGNETIC DATA. A. E. Sandström (Uppsala Univ.). Astronaut. Acta, 7: 141-9(1961). (In English)

The Forbush decrease, marking the start of a cosmic ray storm, is normally associated with the sudden commencement of a geomagnetic storm. A study has been made concerning the possibility to predict the former from the latter with a time lag allowing for the preparation of high altitude studies. (auth)

26811 INTENSITY VARIATIONS IN OUTER VAN ALLEN RADIATION BELT. S. E. Forbush, D. Venkatesan, and C. E. McIlwain (State Univ. of Iowa, Iowa City). J. Geophys. Research, 66: 2275-87(Aug. 1961).

Using data from Explorer VII, the changes in the intensity of the outer Van Allen radiation belt were investigated in detail over the period October 26, 1959, to December 9, 1959. To relate the intensities to location in the belt, the parameter L was used. L is defined as a function of the integral invariant I and scalar magnetic field B, such that everywhere on the shell described by the motion of a trapped particle in the earth's magnetic field, L closely approximates the equatorial radius of the shell. For the period under study, the intensity variations at selected values of L were negatively correlated with geomagnetic activity. However, an analysis of data over a much longer period is required to determine whether this correlation is statistically significant. For the period studied, the decrease in measured intensity during periods of magnetic storms (large a_p) is consistent with the idea that some of the particles are 'dumped' into the auroral and subauroral zones where they may partly contribute to the auroral zone currents that account for a_p. In addition, the reduction in intensity generally occurred in the outer part of the zone. The low values of intensity, for L = 3.5, 4.1, and 4.7, oc-

curred in the interval November 22 to December 9, at times when the equatorial ring current field, U (southward on the earth at the equator), was large. Thus, U cannot be due to the westward current due to the longitudinal drift of measured trapped particles in the region for which L is greater than 3.5, since a decrease in particle density therein would diminish the westward drift current with a consequent decrease in U, which is opposite to what is observed. This result indicates that the site of the ring current is either elsewhere, or that the principal contribution to it comes from drifting particles having energies below the detection thresholds of Explorer VII equipment. The phenomena were investigated over a longer period, using daily averages of the maximum counting rates. This procedure had serious limitations. (auth)

26812 SOME EFFECTS OF DIAMAGNETIC RING CURRENTS ON VAN ALLEN RADIATION. A. J. Dessler (Lockheed Aircraft Corp., Missiles and Space Div., Palo Alto, Calif.) and Robert Karplus. J. Geophys. Research, 66: 2289-95(Aug. 1961).

The distortion of the geomagnetic field by diamagnetic ring currents (such as the magnetic storm main phase ring current) is calculated quantitatively. It is shown that these distortions cause changes in the energy of the trapped electrons in the outer zone of the Van Allen radiation belt. The changes are brought about by betatron acceleration and deceleration of the trapped radiation as the distortions move the radiation from one field strength region into another. A model is presented involving a system of two diamagnetic ring currents for which there is some observational evidence. In this model part of the geomagnetic storm energy is temporarily transferred to the Van Allen radiation. It is proposed that such a mechanism contributes, in part, to the major fluctuations in the observed intensities of the outer zone of the radiation belt because (1) the changes in particle energy cause changes in the counting rate of radiation instruments flown through the belt, and (2) the Van Allen electron number density is a steep function of radial distance so that distortions of the geomagnetic field can cause changes in particle flux. (auth)

26813 ENERGY SPECTRUM AND ANGULAR DISTRIBUTIONS OF ELECTRONS TRAPPED IN THE GEOMAGNETIC FIELD. J. B. Cladis (Lockheed Aircraft Corp., Missiles and Space Div., Sunnyvale, Calif.), L. F. Chase, Jr., W. L. Imhof, and D. J. Knecht. J. Geophys. Research, 66: 2297-2312(Aug. 1961).

The energy spectrum and the pitch-angle distribution of the electrons near the lower edge of the outer radiation zone were measured by means of a collimated magnetic-deflection spectrometer carried in a Javelin rocket. The rocket was launched from Wallops Island, Virginia, and reached an altitude of 1045 km. Along the ascent trajectory, the rocket followed closely a geomagnetic line of force, permitting measurements of the electron flux to be made along the reflection points of the electrons. The pitch-angle distributions of the electrons were found to be symmetrical about 90° and to have widths that increased as the rocket moved up the magnetic field line. The widths of these distributions at half-height were found to be 31.2° at 730 km and 41.6° at 920 km. The spectrometer data yield a spectrum which can be fitted well by the form $E^p \exp(-qE)$, where $p = 1.60^{+0.74}_{-0.44}$, $q = 0.022^{+0.0025}_{-0.0018}$ kev^{-1}, for E > 50 kev. Within the accuracy of the measurements, no change in spectrum shape was observed at altitudes greater than about 600 km. At apogee the omnidirectional intensity of electrons of energies greater than 50 kev was found to be $4.2 \pm 0.8 \times 10^6$ electrons/cm^2-sec. (auth)

26814 THE OBSERVED OUTER-BELT ELECTRON DISTRIBUTION AND THE NEUTRON DECAY HYPOTHESIS. W. N. Hess (Univ. of California, Livermore), J. Killeen, C. Y. Fan, P. Meyer, and J. A. Simpson. J. Geophys. Research, 66: 2313-14(Aug. 1961).

Measurements of electron flux along a line of force in the outer radiation belt are compared with calculations that assume that all electrons are injected by neutron decay. The comparison shows that the two distributions are quite different at intermediate and low latitudes where corrections are unimportant. It is concluded that other processes, in addition to electron injection by neutron decay, are necessary to explain the experimentally observed flux distribution along a line of force. (auth)

26815 THE OBSERVATION OF CORPUSCLES BY MEANS OF THE THIRD ARTIFICIAL EARTH SATELLITE. V. I. Krasovskii, Yu. M. Kushner, G. A. Bordovskii, G. F. Zakharov, and E. M. Svetlitskii. Translated by R. Matthews from Iskusst. Sputniki Zemli, No. 2, 59(1958). Planetary Space Sci., 5: 248-9(July 1961).

An observation of corpuscular streams was attempted with the third Soviet artificial earth satellite. Indicators in the form of two fluorescent screens of ZnS(Ag), covered with aluminum, were used. Electric signals were applied to the memory storage device and then transmitted to earth. Brief remarks are made regarding the origin of the observed corpuscles. (L.N.N.)

26816 ON THE RELATION BETWEEN THE INTENSITY DECREASE OF COSMIC-RAYS DURING COSMIC-RAY STORMS AND SOLAR ACTIVITY. Hachiro Takahashi. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: 59-65 (June 1961). (In English)

A statistical study of the relation between the intensity decrease of cosmic rays during a cosmic-ray storm and solar activity is presented. Cosmic-ray meson data obtained at Itabashi during the period from 1948 to 1956 are used in the study. Results obtained are as follows: annual means of time differences between the onset of cosmic-ray storms and the time of intensity minimum during the storms have a good correlation with the relative sunspot numbers which are the measure of the solar activity; annual means of decrements of cosmic-ray intensity during cosmic-ray storms have a good correlation with the solar activity. These results are interpreted by a magnetic cloud model. (auth)

26817 SOME PROBLEMS OF THE THEORY OF COSMIC RAY VARIATIONS. L. L. Dorman and E. I. Feinberg. p.49-57 of "Variatsii Kosmicheskhkh Luckei Pod Zemlei, na Urovne Morya i.v. Stratosphere." Moscow, Interdepartmental Committee on the International Geophysical year of the U.S.S.R., 1959.

Certain consequences are described from the theory of the effect of the solar corpuscular streams on the intensity of cosmic rays, when the corpuscular rays carry frozen regular magnetic fields. It is shown that this theory explains well the observed decreases in the intensity of the cosmic rays during magnetic storms; the variation of the intensity is totally determined by the nature of the capture of the earth by the corpuscular stream (by the leading front or the by-side). It is known that the duration of the decrease in the intensity of the cosmic rays is considerably greater than the duration of the geomagnetic disturbances. The assumption is made that the lines of force of the magnetic field frozen in the corpuscular stream run out beyond the boundaries of the latter and are circuited at the sun (if the general solar field is frozen in) or in the interplanetary space (if the field of the sunspots is frozen in). In this

manner, the region scattering the cosmic rays increases, which leads to the increase in the duration of the decrease effect of cosmic ray intensity. In connection with the fact that the observed variations in the cosmic ray intensity extend to energies of not lower than about 100 Bev, it is necessary to know the relation coefficient between the variations of the primary and secondary components of the cosmic rays for underground observations. Basing on sufficiently accurate results of rating the relation coefficient for counter telescopes on sea level, the relation coefficients are calculated for underground investigations at various depths down to 2000 m of water equivalent under certain simplifying assumptions. (OTS)

Criticality Studies

26818 FLUX PLOTTING IN SOURCE-FED, SUB-CRITICAL ASSEMBLY. D. G. Andrews and A. R. Dastur (Univ. of Toronto). Can. Nuclear Technol., No. 1, 14-18 (Summer 1961).

A small boron trifluoride detector is traversed through the core at a steady rate so as to give a continuous plot of thermal neutron flux with distance. The horizontal and vertical flux distributions are plotted for various lattice pitches of a sub-critical, natural uranium, heavy water assembly, and the information obtained is used to determine the lattice constants. The performance of the BF_3 counter is assessed by theoretical flux distributions. The choice of dimensions and circuit parameters for minimum errors are also discussed. (N.W.R.)

Elementary Particles and Radiations

26819 (AFCRL-TN-60-1126) PRODUCTION AND INTERACTIONS OF ELECTRON BEAMS IN CROSSED FIELDS. Scientific Report No. 10. C. W. Hartman (California. Univ., Berkeley. Electronics Research Lab.). Oct. 31, 1960. Contract AF19(604)-2270. 98p. (AD-254709)

Production and turbulence of self-sustained, multimegawatt, crossed-field electron beams are studied in the smooth-anode magnetron with cold cathode. A description of turbulence, based on slipping-stream instabilities resulting from velocity shear in the beam, is formulated in terms of simple diffusion relationships. The theory accounts for cathode bombardment, transverse diffusion, violation of magnetron cutoff, and other observed characteristics and agrees quantitatively with experiment. Rf interaction with the high-power beams that may be produced is studied for a class of anode structures based upon space-harmonic interaction principles. Several structures are discussed that show promise of obtaining high-efficiency coherent-phase interaction over areas large compared to a wavelength. (auth)

26820 (IA-628) Y^{*0} EFFECTS IN THE REACTION $K^- + p \rightarrow \Sigma + \pi$ ON COMPLEX NUCLEI. P. Abrahamson and D. Kessler (Israel. Atomic Energy Commission, Tel-Aviv) and Y. Eisenberg and G. Yekutieli (Weizmann Inst. of Science, Rehovoth, Israel). May 1961. 6p.

Experimental studies of the effects of Y^{*0} production in the absorption of K^- mesons at rest and in flight in complex nuclei in nuclear emulsions concluded that the existence of $Y^{*0} \rightarrow \Sigma^+ + \pi^-$ was established, the mass of Y^{*0} greater than the mass of $Y^{*\pm}$ by 10 to 15 Mev, the width of the half maximum resonance should be less than 40 Mev, and about $\frac{1}{3}$ of all $\Sigma^\pm + \pi^\mp$ production in K^- absorption by emulsion proceed by the Y^* channel. Suggestions are made concerning the possibility that the multi-nucleon K^- captures at rest are produced by a two-step process through $Y^* : K^- + N$ (bound) $\rightarrow Y^*$ and $Y^* +$ nucleon $\rightarrow$ hyperon-nucleon. (B.O.G.)

26821 (JINR-D-482) REKURENTNOE POSTROENIE UGLOVYKH OPERATOROV (VVEDENIE TSELOGO SPINA I PROIZVOL'NOGO ORBITAL'NOGO MOMENTA. (Recurrent Configuration of Angular Operators. 2. Introduction of Integral Spin and Arbitrary Orbital Moment). Ya. Fisher and S. Chulli (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 27p.

A method is given for constructing angular operators using only differential operators and eliminating complex summing related to Ciebsch-Gordan coefficients and Pack or Fano transformations. The angular operator variations induced by a supplemented orbital moment or integral spin are studied, and formulas are given for practical calculations. (tr-auth)

26822 (JINR-P-112) RASSEYANIE CHASTITS VYSOKIKH ENERGII (LEKTSII PROCHITANNYE NA LETNEI KONFERENTSII YUGOSLAVSKIKH FIZIKOV NA OSTROVE LOGSHIN 13-27 IYULYA 1957 GODA). (Scattering of High-Energy Particles (Lectures Presented at the Summer Conference of Yugoslavian Physicists at the Logshin Island, July 13-27, 1957)). Ya. A. Smorodinskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1957. 34p.

A compilation is given of 8 lectures on particle interactions, based on an analysis of elastic scattering, particularly N–N scattering. The analysis utilizes only general laws of quantum mechanics and is confined to the nonrelativistic problem. Scattering amplitudes, scattering and density matrices, beam polarization, experimental determination of the scattering matrix, polarization in scattering on nuclei, and hyperons and antinucleons are discussed. (R.V.J.)

26823 (JINR-P-145) OPERATSII ZARYADOVOGO SOPRYAZHENIYA I OTRAZHENIYA PROSTRANSTVA I VREMENI. (Operation of Charge Conjugation and Space-Time Reversal). V. G. Solov'ev (Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1958. 23p.

A systematic account is given of the behavior of operators and functions in P, C, T operations and in their combinations PT, PC, CT, and PCT. Investigations were made of interaction and wave function Lagrangians suitable for describing baryons and mesons. (R.V.J.)

26824 (JINR-P-258) KINEMATICHESKII ANALIZ UGLOVYKH RASPREDELENII. (Kinematic Analysis of Angular Distributions). G. I. Kopylov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1958. 19p.

An attempt is made to determine the energy of angular distribution of particles in the center mass system by measuring only the angular distribution under laboratory conditions. Two events were analyzed and resolved by adopting certain supplementary conditions (restoring secondary particle energy spectra). (tr-auth)

26825 (JINR-P-278) METOD POLUCHNIYA PRODOL'NO–POLYARIZOVANNOGO PUCHKA PROTONOV. (Method for Producing Longitudinally Polarized Proton Beam). S. B. Nurushev, Yu. P. Kumekin, K. S. Marish, and G. D. Stoletov (Joint Inst. for Nuclear Re-

search, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 15p.

Production of longitudinally polarized proton beams in a synchrocyclotron was analyzed. It was found that with an absolute field magnitude sufficiently strong to confine the beam to the required angle, it is more efficient to utilize a section with truncated cross section because the central field Hy remains almost unchanged and the beam is not deformed by the small gradients. Beam confinement between two 4 × 4 cm sectors, 60 cm long was determined. The gap between the sectors was 11 cm. The angle of beam confinement was ≈2.5°, and the beams followed the direction of the principal collimator. (R.V.J.)

26826 (JINR-P-306) K VOPROSU O MEKHANIZME ZAKHVATA OSTANOVIVSHIKHSYA K^- MEZONOV. (On the Capture Mechanism of Stopped K^- Mesons). D. K. Kopylova, Yu. B. Korolevich, N. I. Petukhova, and M. I. Podgoretskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1959. 7p.

The mechanism of stopped K^- capture by emulsion nuclei is analyzed, and the fraction of two-nucleon capture is calculated on the basis of the number of π mesons emitted in the σ_K star. On the basis of the surface model for single-nucleon capture, the fraction of two-nucleon capture is close to 30%. (R.V.J.)

26827 (JINR-P-328) O POGLOSHCHENII π^+ MEZONOV S ENERGIEI OKOLO 50 MEV YADRAMI UGLERODA. (On the Absorption of π^+ Mesons of Nearly 50 Mev Energy by Carbon Nuclei). Zh. V. Laberrig, M. P. Balandin, and S. Z. Otvinovskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 13p

The stars formed by 50 ± 20-Mev π meson absorption by carbon nuclei were studied using a propane bubble chamber. The cross sections of the stars were found to be 145 ± 36 mb. Star distributions were determined by the number of prongs (average = 2.6 ± 0.3). A considerable anisotropy was observed in the angular distribution of prongs in relation to the π^+ direction. It is postulated that prior to the absorption, scattering on separate nucleons in the nucleus must serve as a source of anisotropy. The distribution of two-prong stars was found in relation to the angle between the prongs. (tr-auth)

26828 (JINR-P-330) ANALIZ UPRUGOGO p–p RASSEYANIYA S UCHETOM OBRAZOVANIYA MEZONOV. (Analysis of Elastic p–p Scattering Considering the Formation of Mesons). A. F. Pisarev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 40p.

Elastic p–p scattering at ~650 Mev was analyzed for π meson production processes. The experimental program for determining matrix elements was studied with the assumption that the $l \leq 4$ condition is the basic contributor in the interaction. Expressions are developed for differential cross sections, polarization, and polarization tensors describing the nucleon spin state variations. Relativistic transformation formulas were used in seeking polarization and correlation tensor components in the center of mass system. (tr-auth)

26829 (JINR-P-337) SPEKTRAL'NOE USLOVIE KAK SPOSOB PERENORMIROVKI. (Spectral Condition as a Renormalization Method). B. V. Medvedev and M. K. Polivanov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1959. 7p.

An analysis is made of P. Redmond's (Phys. Rev. 112, 1404, 1958) modification for Green's function renormalization by adding a counter factor (f', f) which in relativistic theory does not cause complications. (R.V.J.)

26830 (JINR-P-424) MNOZHESTVENNOE ROZHDENIE CHASTITS V STOLKNOVENIYAKH (π–p) PRI ENERGII V NESKOL'KO BEV. (Multiple Production of Particles in (π–p) Collisions at Several Bev). B. V. Eliseev and V. V. Pashkevich (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1959. 4p.

Relative reaction probabilities in interactions between 1.7 and 3 Bev π mesons and protons are studied. Calculations of spatial volume assume that K mesons are produced in a volume determined by Compton K-meson wave length; all other particles are produced within the N–π cloud. The mean numbers of produced 1.7 and 3 Bev mesons are 1.86 and 2.50, respectively; among them 1.17 and 1.59 are charged. (R.V.J.)

26831 (JINR-P-434) GENERATSIYA PROTONAMI S ENERGIEI 9 BEV STRANNYKH CHASTITS V YADRAKH FOTOEMUL'SII. (Proton Production of Strange Particles on Emulsion Nuclei at 9 Bev). V. A. Belyakov, V. V. Glagolev, L. F. Kirillova, N. N. Mel'nikova, M. Suk, and K. D. Tolstov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1959. 10p.

Cross sections were evaluated for strange particle production on emulsion nuclei $\sigma^S_{compl} = (28 \pm 8)$mb and for N – N collisions $\sigma^S_{compl} \lesssim 1$mb. The experiments demonstrate a comparatively low production rate for K^- and charged hyperons and a strong interaction of λ^0 hyperons with nucleons. (tr-auth)

26832 (JINR-P-473) EKSPERIMENTAL'NYE DANNYE PO UPRUGOMU NUKLON–NUKLONOMU VZAIMODEISTVIYU. (Data on Elastic Nucleon–Nucleon Interactions). S. B. Nurushev and Ya. A. Smorodinskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 31p.

Cross section and polarization data, based on triple scattering and correlation parameters at energies exceeding 100 Mev, are tabulated. The tables include data published in 1958 and the first half of 1959. (R.V.J.)

26833 (PAN-230/VII) NUMERICAL SOLUTIONS OF THE "SUPERCONDUCTIVITY EQUATIONS" FOR NUCLEI IN THE TRANSURANIC REGION. Z. Szymanski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). May 1961. 15p.

The variational formalism of superconductivity theory is applied to nucleon-nucleon interactions in nuclei. The formalism is used to calculate the equilibrium deformations of even-even nuclei with proton number Z and neutron number N such that $86 \leq Z \leq 98$ and $130 \leq N \leq 150$. (T.F.H.)

26834 (UCRL-9597) A STUDY OF K MESONS IN ANTIPROTON-PROTON ANNIHILATION (thesis). George Randolph Kalbfleisch (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 7, 1961. Contract W-7405-eng-48. 123p.

A study is made of K meson production in p–$\bar{p}$ annihilation. The data consist of 287 $K\bar{K}n\pi$ annihilation events, with observed K meson decays. The experiment is performed in a liquid hydrogen bubble chamber at $\bar{p}$ momenta of 1.61 and 1.99 Bev/c. The total numbers of antiproton interactions in the sample are 14,562 ± 300 and 2200 ± 300 at each of the two momenta, respectively. Many of the events fit two or more hypotheses. Ambiguities as to the multiplicity of the final state are resolved by analysis of ideograms of the square of the missing mass. Ambiguities remain as to which particle is the second K meson. Half of the events fit only one hypothesis and are unambiguous. Fermi statistical model and phase space calculations are performed using the Lorentz invariant phase space. The multiplicity

distribution for all pion annihilation agrees with a Fermi statistical model. This model predicts pion multiplicities associated with a $K\bar{K}$ pair in agreement with the experimental results. The average multiplicities for $KKn\pi$ annihilation, and the fraction of the annihilation yielding $KKn\pi$ final states are observed at 1.61 and 1.99 Bev/c. These fractions are in agreement with the Fermi statistical model. The multiplicities and fraction of annihilation into $KKn\pi$ at lower energies also agree with predictions of the Fermi model. The momentum spectra of the K and π mesons and the angular distributions between pairs of particles in the antiproton-proton center of mass system are in agreement with the predictions of phase space for each multiplicity of the final state (three-, four-, five-, and six-body). The angular distributions of the K and π mesons relative to the antiproton direction deviate from isotropy. The distribution in the effective mass of $K\bar{K}$ pairs is consistent with the predictions of phase space. However, the mass distributions of $K\pi$ (or $\bar{K}\pi$) pairs deviate from phase space and show effects consistent with $K\pi$ and $K\pi$ resonances. (auth)

26835 (AEC-tr-4750) MOTION OF CHARGED PARTICLES IN HIGH-FREQUENCY ELECTROMAGNETIC FIELDS. M. A. Miller. Translated by Lydia Venters (Argonne National Lab.) from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 1: No. 3, 110(1958). 20p.

The motion of single charged particles in nonuniform high frequency electromagnetic fields is discussed. A generalization of the averaged motion equations to the case of simultaneous operation of constant magnetic and high-frequency electromagnetic fields is carried out. The problems solved include the reflection of particles from high-frequency barriers, focusing rectilinear beams of charged particles by fields of traveling and standing electromagnetic waves, and localization of the particles in a limited space region. (J.R.D.)

26836 (JPRS-5980) ON THE DISPERSING PROPERTIES OF A MEDIUM IN THE PRESENCE OF VERY HIGH DENSITIES AND TEMPERATURES. Report II. G. S. Saakyan. Translated from Doklady Akad. Nauk Armyan. S.S.R., 30: No. 4, 211-18(1960). 14p.

The dispersion of high frequency electromagnetic radiation by media at high densities and temperatures, such as exist in white dwarf stars, is studied. The cases are considered in which the electronic gas is degenerate and non-degenerate, for both degenerate and non-degenerate nucleonic media (the media are assumed to be mainly neutrons). Conditions are described under which the dispersion is determined by the electrons or by the neutrons, and under which the dispersion occurs by means of the photoproduction of pions or electron pairs. Conditions for emission of Cherenkov radiation, as well as calculations of the Cherenkov spectra, are presented. (T.F.H.)

26837 PION INTERACTION IN FERMI STATISTICAL THEORY. V. S. Barashenkov (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Polon., 20: 471-4(1961). (In English)

By assuming a π-π resonant interaction, the energy spectra of pions and nucleons generated in inelastic N-N collisions at E = 9 Bev have been calculated. The results of the calculations are compared with experiment. (auth)

26838 THE SPECTRA OF X RAYS SCATTERED IN LOW ATOMIC NUMBER MATERIALS. W. R. Bruce and H. E. Johns (Ontario Cancer Inst., Toronto and Univ. of Toronto). Brit. J. Radiol., Suppl. No. 9, 1-57(1960).

An examination of the methods for calculating the intensity flux of scattered radiation from x-ray beams in low atomic number materials indicated that the most feasible approach consists of a combination of analytic and Monte Carlo methods. The contribution of once-scattered radiation is calculated analytically and added to the results for multiple scatter. This method was used to study the penetration of x rays of 50, 100, 200, 500, and 1250 kev radiation into semi-infinite scatterers to depths up to three mean free paths. The intensity spectra are presented for the penetration of radiation from an infinite plane parallel source in a Compton scatterer, water, and aluminium and for the penetration of beams of various areas in water. Build-up factors and depth doses were calculated from these spectra. All data presented apply to the axis of the beam. (auth)

26839 ON THE ANGULAR MOMENTUM WEIGHT FACTOR IN THE STATISTICAL THEORY OF MULTIPLE PARTICLE PRODUCTION. [PART] II. Ziro Koba (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Bull. acad. polon. sci., Ser. sci., math., astron. et phys., 9: 395-401(1961). (In English)

An asymptotic expansion (for $n \gg 1$ and $\Sigma l_i^2 \gg l_j^2$) of the angular momentum weight factor Z_n of the statistical theory of multiple particle production is worked out. (auth)

26840 THE PENTADIMENSIONAL REPRESENTATION OF PARTICLES OF SPIN 2, 1, AND 0. Sylvie Lederer. Compt. rend., 252: 3946-8(June 19, 1961). (In French)

A variational principal gives, in a five-dimensional euclidian space, equations formally identical to the quadridimensional equations of the particles of spin 2. The linear approximation of the equations of the theory of Jordan-Thiry permits the interpretation of the symmetric tensor field introduced. (tr-auth)

26841 A NONRELATIVISTIC WAVE EQUATION FOR PARTICLES OF SPIN 1. Jean Penné. Compt. rend., 252: 4126-8(June 26, 1961). (In French)

The hypothesis of a permanent structure with spherical symmetry of the particles and the consideration of Euler variables necessary to its description permits, for particles of spin 1, an equation to be written analogous to that found by Pauli for the electron. (tr-auth)

26842 THE DAMPING OF PARTICLE OSCILLATIONS IN A GENERAL FIELD WITH PERIODIC STRUCTURE. [PART] I. J. Teichman and R. Klima (Inst. of Vacuum Electronics, Czechoslovak Academy of Sciences, Prague). Czech. J. Phys., B11: 307-19(1961). (In Russian)

A linear theory is derived, discussing the dynamics of particles in the region of an equilibrium orbit in a general electromagnetic field, which forms a periodic system. The total particle damping is determined from the Hamiltonian found and from dissipative forces brought out by a classical reaction radiation. Relations for the damping of the synchrotron oscillations are derived from the study of the appropriate phase space. (auth)

26843 INVARIANT IMBEDDING AND TRANSPORT THEORY: A UNIFIED APPROACH. G. Milton Wing (Sandia Corp., Albuquerque, N. Mex.). J. Math. Anal. and Appls., 2: 277-92(Apr. 1961). (SCR-401)

Invariant imbedding formulations of several important transport problems are derived from the reduction of two-point value problems to initial value problems. The results of this derivation are applied to a classical problem of transport in a slab, assuming discrete angular dependence. The results suggest analogous results for continuous angular dependence in the transport in the slab, and the formulations are also applied to this problem. The results are also obtained for time-dependent problems. In all these formulations, the functions are assumed to be sufficiently con-

tinuous and differentiable to justify the operations performed. This formalism is discussed and the possibility of putting the invariant imbedding method on a rigorous basis is analyzed. (N.W.R.)

26844 A THEORY OF LEPTONS. R. H. Tzou (Institut Henri-Poincaré, Paris). J. phys. radium, 22: 257-66(May 1961). (In French)

A unified model is proposed for the electron and muon, where the two leptons form an M doublet. The theory is based on the symmetrization of the mass term in the equation of a spinor field, that has also a certain self-coupling. This spinor field has two different rest-mass states, that are identified with the electron and muon. The four-component neutrino is a special case in this M doublet model. The non-conservation of parity in the weak interaction is a consequence of the M symmetry principle. The fundamental leptonic weak current is of the type V only and thus resembles exactly the electron-muon electric current. The neutrinos coupled to the electron and muon in the weak current are two particles of opposite helicity, which are the two members of a four-component neutrino. The existence of solutions of the fundamental field equation in monochromatic plane waves is proved. The theory causes no modification to the classic results and conclusions of the usual electron theory in atomic physics. Possible generalization of the M doublet model to baryons and mesons is also discussed. (auth)

26845 COMPARED KINEMATICS OF THE ELASTIC SCATTERING OF μ MESONS AND ELECTRONS. Paul Kessler (College de France, Paris). J. phys. radium, 22: 322-4(May 1961). (In French)

The idea of making comparative experiments on the elastic scattering of μ mesons and electrons has been suggested. For such an experiment either the initial pulse or the scattering must be slightly different. These differences are calculated. (J.S.R.)

26846 TRANSMISSION AND LINE BROADENING OF RESONANCE RADIATION INCIDENT ON A RESONANCE ABSORBER. S. Margulies and J. R. Ehrman (Univ. of Illinois, Urbana). Nuclear Instr. & Methods, 12: 131-7(June 1961). (In English)

The transmission of resonance radiation emitted from a source of finite thickness and passing through an external resonance absorber is discussed. The transmission integral is examined for both a linear and a Gaussian distribution of radioactive atoms in the source. Several special cases are presented, and the general case is evaluated by numerical integration. Over the range of values considered, the transmitted line shape closely approximates a Breit-Wigner curve whose width is greater than the natural width of the transition. This line broadening, caused by resonance absorption in the source and in the external absorber, is presented graphically as a function of source and absorber thickness. (auth)

26847 INELASTIC SCATTERING FROM HAFNIUM AND WOLFRAM ISOTOPES. O. Hansen, M. C. Olesen, O. Skilbreid, and B. Elbek (Univ. of Copenhagen). Nuclear Phys., 25: 634-41(1961). (In English)

The reduced electric quadrupole transition probabilities and the excitation energies of the accessible low lying states in the stable isotopes of Hf and W (except the rare isotope W^{180}) were measured by Coulomb excitation. The measurements were performed on inelastically scattered protons and deuterons recorded in a heavy particle spectrograph. The results are discussed in terms of the rotational model. The measured transition probabilities are compared with these derived from lifetime measurements. (auth)

26848 ABOUT THE PION-HYDROGEN RESONANCE. P. G. O. Freund, A. M. Longoni, and E. Predazzi (Univ. of Vienna). Nuclear Phys., 25: 659-60(1961). (In English)

The spectral function of the Σ hyperon propagator calculated with the aid of a method proposed by Redmond under the assumptions of odd $\Sigma-\Lambda$ relative parity and strong $(\Sigma\Lambda)\pi$ interaction is used for a theoretical derivation of the position and width of the $\Lambda-\pi$ resonance recently discovered by Alvarez et al. The computed figures are in good agreement with experimental data. The same method is applied also for a discussion of the possibility of a high energy (1,1) $\pi-N$ resonance and for the computation of the low energy, (1,1) cross-section in $\pi-N$ scattering. (auth)

26849 ON THE PHENOMENOLOGICAL ANALYSIS OF THE S-MATRIX IN MULTIPLE PRODUCTION. D. Ito, A. H. Zimerman, S. Ragusa, and T. Miyazima (Instituto de Física Teórica, São Paulo, Brazil). Nuovo cimento (10), 20: 878-902. (In English)

An attempt is made to analyze the structure of S-matrix elements for multiple production by phenomenological considerations based upon the two center model. Two assumptions are made: 1) the momentum distributions of pions emitted in the for- and backward cones are isotropic in each center-of-mass system (the fire ball rest system) and the average values ϵ_0 of the pion energies in this system do not depend on the details of collisions; 2) the mean value of the momentum transfer Δ is always of the order of the nucleon mass M. From these assumptions the following results are derived: 1) the multiplicity is given by $n \simeq \xi\sqrt{2E_0|\Delta|}/\epsilon_0$, where ξ is the ratio M/M_{max} of the fire ball mass M and its maximum value M_{max}. Experimentally, $\xi \simeq 0.5$ at 10^{13} ev; 2) the lower limit of the inelasticity K is given by $K \geq \xi^2$. At 10^{13} ev $K \geq \xi^2 \simeq 0.2$ which is consistent with experiments. The relation between multiplicity and inelasticity is discussed; 3) in the center-of-mass system of the fire ball and the recoil nucleon ("isobar system" IBS), the ratio $|\overline{p}|/M$ of the momentum of the nucleon $\overline{p}$ and the fire ball mass M is also expressed by the parameter ξ as $|\overline{p}|/M = (1-\xi^2)/2\xi$. At 10^{13} ev $|\overline{p}|/M \simeq 1$. This means that an equipartition of energy is approximately valid for the three possible degrees of freedom: the motion of the recoil nucleon, the translational and internal motion of the fire ball. $|\overline{p}| \ll M$ is excluded, unless K is unity, contrary to experiments; 4) when the equipartition holds, the mean value of the transverse momentum is constant and its value is of the order of ϵ_0. The M and n-dependence of the S-matrix is also discussed, and by using the corresponding results the asymmetry is estimated in numbers of particles n_1 and n_2 emitted in the for- and backward cones. The parameter $[\langle(n_1-n_2)^2\rangle/\langle(n_1+n_2)^2\rangle]^{1/2}$, a measure of the asymmetry, becomes $1/3$ due to statistical fluctuation alone. It becomes larger if the energy transfer Δ_0 is not zero. Discussion is also made of the condition by which the average value ϵ_0 of the pion energy in the fire ball is constant. The properties of the fire ball seem to be independent from the mechanism of its production. Extending this point of view, the similarity between the multiple production in $N-N$ collisions and $N-\overline{N}$ annihilation is discussed. (auth)

26850 THE DECAY MODES AND LIFETIME OF NEGATIVE K-MESONS. B. Bhowmik, P. C. Jain, and P. C. Mathur (Univ. of Delhi). Nuovo cimento (10), 20: 857-77(June 1, 1961). (In English)

Two emulsion stacks, exposed to magnetically analyzed enriched K^- beams of average momentum 430 and 440 Mev/c, have been used to estimate the relative abundance and lifetime of K^- mesons. While following 103 m of track length, 48 decay-like events were observed. From the analysis of events with good geometry the following decay

modes have been established: $K_{\mu 2}$, $K_{\pi 2}$, $K_{\mu 3}$, $K_{\pi 3}$ (τ') and K_{β}. No example of τ^- decay was found in the line scan sample, but the mode has been established from an area scan event. No knowledge of K^+ decay modes, or of the mass of the primary particle was assumed in the analysis. The mean mass, obtained from the decay kinematics of $K_{\mu 2}$ and $K_{\pi 2}$ mode, is $(965.8^{+19}_{-21.5})$ m_e. The mass value from τ^- decay mode is found to be (964.45 ± 2.91) m_e. The percentages of various decay modes are as follows: $K_{\mu 2}$ (56.0 ± 12.8), $K_{\pi 2}$ (33.4 ± 8.7), $K_{\mu 3}$ (5.9 ± 3.1), $K_{\pi 3}(\tau')$ (2.7 ± 2.8), $K_{\beta 3}$ (2.9 ± 1.9), and τ^- $(0 + 2.0)$. The mean lifetime has been determined after detailed considerations of the contamination due to decay-like clean interactions, and losses due to missing secondaries. The mean lifetime is $(1.27^{+0.36}_{-0.23}) \cdot 10^{-8}$ sec. (auth)

26851 ON THE EFFECT OF n-p TENSOR FORCES IN H^3_Λ–I. B. Barsella and S. Rosati (Università, Pisa, Italy and Istituto Nazionale di Fisica Nucleare, Pisa, Italy). Nuovo cimento (10), 20: 914-27(June 1, 1961). (In English)

Calculations have been done on the hypertriton with a hamiltonian containing a neutron-proton potential with a tensor part. The integral volume of Λ-N interaction and the wave function parameters are modified to a certain extent with respect to the results of preceding calculations, performed with a purely central potential. It is concluded that a more refined calculation will be necessary to get a definite answer to the question of the importance of n-p tensor corrections in H^3_Λ. (auth)

26852 A DISCUSSION OF THE NOYES AND WONG EQUATION FOR POTENTIAL SCATTERING. V. De Alfaro and T. Regge (Università, Turin and Istituto Nazionale di Fisca Nucleare, Turin). Nuovo cimento (10), 20: 956-62(June 1, 1961). (In English)

A discussion is outlined on the Martin form of the Noyes and Wong equation in potential theory. A theorem is given about the connection between zeros of the discontinuity of the S-function and the resonant states. (auth)

26853 SUPERFLUIDITY AND PERTURBATION EXPANSION IN A LARGE FERMI SYSTEM. A. Tomasini (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10), 20: 963-76(June 1, 1961). (In English)

The Bogoliubov-Valatin canonical transformation is performed, then the perturbation approach for the evaluation of the true states of a large Fermi system is examined. It is shown that the difficulty of the usual perturbation expansions due to the pole in the Brueckner t matrix is in general overcome by this procedure. It is shown that the corrections introduced by the interaction between the quasi-particles in the excitation energy are of the same order of magnitude of the excitation energy itself in the region of its minimum. These corrections appear to be slowly dependent on the strength of the interaction. An approximation is introduced which is an extension of the Brueckner one. (auth)

26854 PRODUCTION OF δ–ELECTRONS IN DISTANT COLLISIONS BY CHARGED ULTRARELATIVISTIC PARTICLES. V. Bortolani (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10), 20: 977-82(June 1, 1961). (In English)

A method is discussed for determining the connection between the number of δ electrons, extracted by distant collision of an ultrarelativistic particle with the electrons of a medium, and the $\gamma = 1/\sqrt{1-(v/c)^2}$ of the particle. The Weizsäcker-Williams method is used to reduce the problem to a photoelectric effect. Hydrogen atom type eigenfunctions are used to describe the metallic electrons. Errors due to this approximation are estimated. (auth)

26855 ON SOME CONSEQUENCES OF CHARGE INDEPENDENCE FOR K^+–N NUCLEON INTERACTIONS. V. de Santis (Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10), 20: 983-1000(June 1, 1961). (In English)

An attempt is made to find consistent relations between the three K^+–N cross sections assuming the validity of charge independence. It is seen that, in this spirit, the K^+–n elastic cross section should be much greater than previously deduced from counter and emulsion experiments. These experiments are then analyzed and the possibility of increasing the value deduced from them for this cross section, bringing it in the limits required by charge independence, is shown to be consistent with reasonable changes of the parameters of the nuclear model used in the analysis of this interaction. Finally, a Tamm-Dancoff calculation in terms of pseudoscalar KNY coupling, taking into account the recoils, is made; a somewhat good fit with the experimental data is found, with values of the two coupling constants g_Σ and g_Λ of the same order of magnitude as the π–N one. (auth)

26856 UNIQUENESS OF THE ORBITAL ANGULAR MOMENTUM OPERATORS. J. R. Shewell (Auburn Univ., Ala.). Nuovo cimento (10), 20: 1010-11(June 1, 1961). (In English)

It is shown that the theorem on the uniqueness of orbital angular momentum operators is false. The theorem formulated by J. S. Lomont and H. E. Moses, Nuovo cimento, 16, 96(1960), is concerned with commuting variables in a Hilbert space. The proof is shown to be faulty in that one of the statements is not necessarily true. Furthermore, the theorem is proven false by showing that there exists no unitary transformation relating two self-adjoint operators, as was stated. (L.N.N.)

26857 NUCLEAR EXCITATION AND MULTIPLE PRODUCTION IN PROTON-NUCLEON COLLISIONS AT CERN-PS ENERGIES. G. Cvijanovich (Universität, Bern), B. Dayton, P. Egli, B. Klaiber, W. Koch, M. Nikolić, R. Schneeberger, H. Winzeler, J. C. Combe, W. M. Gibson, W. O. Lock, M. Schneeberger, and G. Vanderhaeghe. Nuovo cimento (10), 20: 1012-16(June 1, 1961). (In English)

The external beam of elastically scattered protons from the CERN Proton Synchrotron was allowed to enter two stacks of Ilford G5 emulsions. Individual tracks were examined and the observations compiled. (L.N.N.)

26858 SOME REMARKS ON SAKURAI'S THEORY OF STRONG INTERACTIONS. A. P. Balachandran (Univ. of Madras) and N. G. Deshpande. Nuovo cimento (10), 20: 1022-3(June 1, 1961). (In English)

Remarks are made concerning a theory on strong interactions (NSA 14: 26207). In general, reactions in which the final state is different from the initial state are not allowed. Consequences of the bilinearity of the Lagrangian are discussed. It is assumed that all the fields are elementary. The theory also does not explain why there is no bound system of an $\bar{n}$ and a Σ^+. (L.N.N.)

26859 A NOTE ON THE FINAL STATE INTERACTION IN $K^+_2\pi$ DECAY. K. Kawarabayashi (Tokyo Univ.). Nuovo cimento (10), 20: 1030-4(June 1, 1961). (In English)

The explanation of $K^+_2\pi$ decay suggested by Good and Holladay (NSA 14: 9936), that of decay through a strict $\Delta I = \frac{1}{2}$ weak interaction, is compared with other explanations (NSA 14: 22330 and 14: 23540) which support a

negative scattering length. Mathematical development along these lines, making use of the technique of dispersion relations and the latter theories, is supported. (L.N.N.)

26860 SOME REMARKS ABOUT THE PHOTOPRODUCTION OF STRANGE PARTICLES. M. Gourdin (Faculte des Sciences, Orsay, France and Faculte des Sciences, Bordeaux, France). Nuovo cimento (10), 20: 1035-7(June 1, 1961). (In English)

Contributions due to resonances are added to the elementary description of strange particle photoproduction. The following model is adopted: Born terms, isobars for the $\pi-N$ resonances, the γ resonance as a correction, and the possibility of a $\pi-K$ resonance in a P state. Calculations are in progress. (L.N.N.)

26861 INTERFERENCES AMONG FEYNMAN GRAPHS OF DIFFERENT TOPOLOGY. E. R. Caianiello and K. Y. Shen (Università, Naples). Nuovo cimento (10), 20: 1038-41(June 1, 1961). (In English)

A given graph or partial sum of graphs, although usually regarded for computational purposes as a compact expression, is in fact a sum of contributions arising from all the individual modes of the free Fermion fields; these contributions may be partly or totally cancelled by others that belong, in the graphical picture, to diagrams which are disregarded by the approximation chosen. Therefore, total antisymmeterization of graphs of special classes does not necessarily ensure the validity of the exclusion principle. It is demonstrated that this principle requires cancellations among terms which belong to graphs of different topology. (L.N.N.)

26862 α-PARTICLE WAVE FUNCTIONS AND THE MUON CAPTURE IN ^{4}He. A. Bietti (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo cimento (10), 20: 1043-5(June 1, 1961). (In English)

It has been shown (NSA 13: 17238) that the total capture rate $\Lambda^{(\mu)}$ is given by $\Lambda\ (He^4) = 8 \cdot 272 \cdot R\ (1 - I)\ s^{-1}$. A calculation of I with different variational wave functions for He^4 is made in order to show the dependence of the results on wave functions with variational parameters; particularly when these parameters are fitted in order to obtain the correct rms radius of the alpha particle. Only S-wave functions are considered. (L.N.N.)

26863 GENERALIZED KOOPMANS' THEOREM. J. C. Phillips (Univ. of Chicago). Phys. Rev., 123: 420-4(July 15, 1961).

Koopmans' theorem states that if the wave function of a many-electron system is approximated by a Slater determinant of Hartree-Fock one-electron wave functions, with one-electron energies defined as the difference in energy of (N + 1)- and N-particle systems, then these one-electron energies are given by the expectation value of the Hartree-Fock Hamiltonian with respect to the one-electron wave functions. Koopmans' theorem is generalized to include correlation effects by using Hubbard's expression for the total energy of a free-electron gas. The resulting one-electron Hamiltonian contains in first-order screened exchange. Hubbard's lowest polarization diagram gives, in addition, part of the screened second-order Coulomb interactions, which is small for metallic densities. Collective terms are also obtained. Comparison with the Bohm-Pines Hamiltonian shows a one-to-one correspondence, but with different cutoff functions in each term. Following Hubbard, the method to include the effects of a periodic potential to first order is extended. The resulting one-electron Hamiltonian provides a convenient and accurate basis for self-consistent energy band calculations including exchange and correlation in metals and semiconductors. (auth)

26864 SEARCH FOR POSITIVE PARTICLES OF MASSES ABOUT 500m_e AND 1400m_e. V. Cook, D. Keefe, L. T. Kerth, P. G. Murphy, W. A. Wenzel, and T. F. Zipf (Univ. of California, Berkeley). Phys. Rev., 123: 655-6 (July 15, 1961). (UCRL-9570)

The mass spectrum of positive particles in a secondary beam from the Bevatron has been measured at a distance of 90 ft from the internal target. At a confidence level of 93% the proportion of particles with mass between 420m_e and 630m_e in the 1-Bev/c beam is estimated to be $< 6 \times 10^{-8}$. An upper limit of about 3×10^{-6} is obtained for the proportion of particles of mass approximately 1400m_e in the 2.3-Bev/c beam. (auth)

26865 PION PRODUCTION IN ELECTRON-POSITRON COLLISIONS. Frank Chilton (Univ. of Chicago and Univ. of Washington, Seattle). Phys. Rev., 123: 656-66(July 15, 1961).

The properties due to the presence of symmetries in pion production processes in electron-positron collisions are discussed. Cross sections are calculated for the production reactions $e^+ + e^- \rightarrow \pi^0 + \gamma$, $e^+ + e^- \rightarrow e^+ + e^- + \pi^0$, and $e^+ + e^- \rightarrow \pi^+ + \pi^-$. The photon spectrum for the reaction $e^+ + e^- \rightarrow \pi^+ + \pi^- + \gamma$ is also calculated. The role of form factors and some of the possible effects of resonant strong interactions are discussed. (auth)

26866 THEORY OF SINGLE PION PRODUCTION IN PROTON-PROTON COLLISIONS. J. Iizuka and A. Klein (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 123: 669-77(July 15, 1961).

Simple pion production in nucleon-nucleon collisions in the Bev energy region is studied by means of the picture due to Weizsäcker-Williams (peripheral interaction model) and in the $(3/2,3/2)$ resonance approximation for the final state pion-nucleon interaction. The excitation curve for the reaction $p + p \rightarrow p + n + \pi^+$, nucleon momentum distributions, and Q-value distributions in the center-of-mass system are calculated and compared with the published experimental data as well as with the work of Lindenbaum and Sternheimer. Agreement is reasonable with both, thus indicating that these particular distributions are insensitive to the isobar production mechanism (single pion exchange), though more recent experiments seem to have indicated clearly a preference for the theory developed here. (auth)

26867 DOMAINS OF DEFINITION FOR FEYNMAN INTEGRALS OVER REAL FEYNMAN PARAMETERS. Tai Tsun Wu (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 123: 678-89(July 15, 1961).

Given a Feynman diagram, the corresponding integral over real Feynman parameters is meaningful and analytic in a certain domain in the space of the Lorentz invariants formed from the external momenta, each of which is on the mass shell. In the case where all the masses are equal, the intersection of these domains for all proper convergent diagrams is studied. For the cases of four and five external lines, the real intersections are explicitly found; for the case of six, seven, and eight external lines, procedures for finding the real intersections are given. A knowledge of the real intersection makes it possible to construct geometrically a subset of the complex intersection. Generalization to unequal external masses is briefly considered. (auth)

26868 PROPERTIES OF NORMAL THRESHOLDS IN PERTURBATION THEORY. Tai Tsun Wu (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 123: 689-91 (July 15, 1961).

Making use of the relation between a Feynman diagram and the corresponding electric circuit, several properties of the normal thresholds are established. (auth)

26869 SINGULARITIES OF SCATTERING AMPLITUDES ON UNPHYSICAL SHEETS AND THEIR INTERPRETATION. R. Blankenbecler, M. L. Goldberger, S. W. MacDowell, and S. B. Treiman (Princeton Univ., N. J.). Phys. Rev., 123: 692-9(July 15, 1961).

The analytic structure of two-particle scattering amplitudes on the unphysical sheet of the Riemann surface reached by crossing the two-particle cut is discussed. The singularities of the amplitudes there are shown to be poles and their physical interpretation is studied. The way in which bound states appear on the physical sheet in the Mandelstam representation, both as isolated poles and as cuts, is traced in detail. The properties of partial wave amplitudes and of the full amplitude as a function of energy and angle and of energy and momentum transfer are discussed. Finally, a few remarks are made in connection with unstable states. (auth)

26870 EXCITATION SPECTRUM IN MANY-BOSON SYSTEMS. Fumihiko Takano (Brown Univ., Providence). Phys. Rev., 123: 699-705(July 15, 1961).

When only two-body correlations are fully taken into account, there appears an energy gap in the excitation spectrum for many-boson systems as shown by Girardeau and Arnowitt and confirmed by Wentzel. This energy gap is shown to disappear and the spectrum to become phononlike again and proportional to the momentum for small momentum, if we construct the eigenmodes of excitations (collective excitations), taking into consideration appropriate higher-order terms. (auth)

26871 TEST OF GLOBAL SYMMETRY IN PION-BARYON INTERACTIONS BY K^- + p REACTIONS. Jogesh G. Pati (Univ. of Maryland, College Park and California Inst. of Tech., Pasadena). Phys. Rev., 123: 705-10(July 15, 1961).

Under the hypothesis that the K meson interactions do not mask the symmetries of the pion-baryon interactions appreciably, the branching ratios of the K^- + p reactions are studied to test the validity of global symmetry. The T^{-1}-matrix formalism of Matthews and Salam is adopted to calculate the branching ratios. The new Dalitz-Tuan solutions for $\bar{K}N$ scattering lengths, which incorporate the (K^+,K^0) mass difference and the new branching ratios of the various K^- + p reactions, presented at Kiev, are adopted in the analysis. The errors in the experimental branching ratios are so chosen as to satisfy the Amati-Vitale inequality. It is found that the a^- and b^+ (also a^+, though poorly) Dalitz-Tuan solutions can explain the branching ratios for K^- captured at rest. The extension of the analysis to 30-Mev incident K^- mesons under the zero-range approximation leads to very poor agreement with experiments. (auth)

26872 RESONANCE MODEL OF $\Lambda - K^0$ PRODUCTION. Akira Kanazawa (Purdue Univ., Lafayette, Ind.). Phys. Rev., 123: 997-1002(Aug. 1, 1961).

A resonance model is proposed to explain the excitation function, the angular distribution, and the large polarization of Λ in the reaction $p + \pi^- \rightarrow \Lambda + K^0$. It is assumed that there exists a low angular momentum resonance in the channel $p + \pi^- \rightarrow$ (resonant state) $\rightarrow \Lambda + K^0$. There are five real parameters in this model. Two of these are the coupling constants of the usual interactions. The other three are the position, half-width, and height of the assumed resonance. With reasonable choices of parameters a fairly good fit is obtained, for both a scalar and a pseudoscalar K meson, to the experimental data in the interval 910 to 1300 Mev of the pion kinetic energy in the laboratory system. (auth)

26873 PHOTOPRODUCTION OF K^+ MESONS FROM DEUTERIUM. R. L. Anderson, F. Turkot, and W. M. Woodward (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 123: 1003-4(Aug. 1, 1961).

The differential cross section for the reaction $\gamma + n \rightarrow K^+ + \Sigma^-$ was measured. The data are obtained by observing the charged K particle with a magnet spectrometer alternately from hydrogen and from deuterium. For γ-ray energy of 1122 Mev and for $\theta_{c.m.} = 82°$, $d\sigma_{n\Sigma^-}/d\sigma_{p\Sigma^0} = 1.6 \pm 0.7$. (auth)

26874 NUCLEON POLARIZABILITY CORRECTION TO HIGH-ENERGY ELECTRON-NUCLEON SCATTERING. N. R. Werthamer (Univ. of California, Berkeley) and M. A. Ruderman. Phys. Rev., 123: 1005-13(Aug. 1, 1961).

The contribution of nucleon polarizability to ultrarelativistic electron-nucleon scattering cross sections is estimated and found to be small for nonforward scattering angles at all energies. (auth)

26875 MEAN LIFETIME OF THE NEUTRAL PION. R. G. Glasser, N. Seeman, and B. Stiller (Naval Research Lab., Washington, D. C.). Phys. Rev., 123: 1014-20 (Aug. 1, 1961).

An estimate of the mean lifetime of the π^0 meson was obtained from an experiment employing a direct time-of-flight technique first attempted by Harris et al. in 1957. This method is based upon the observation in nuclear emulsion of the decay of the $K^+_{\tau 2}$ meson ($K^+ \rightarrow \pi^+ + \pi^0$) and the subsequent decay of the π^0 via the Dalitz mode, $\pi^0 \rightarrow e^+ + e^- + \gamma$. In the present experiment we were able to utilize a new fine-grained emulsion (Ilford L.4) that yielded markedly improved resolution. The availability of the separated K^+ beam from the Bevatron at Berkeley permitted detection and measurement of 76 Dalitz decays. The mean lifetime of the π^0 is $(1.9 \pm 0.5) \times 10^{-16}$ sec. (auth)

26876 CORRELATIONS BETWEEN CUSPS IN DIFFERENTIAL CROSS SECTIONS AND IN POLARIZATIONS. M. Nauenberg and A. Pais (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 123: 1058-65(Aug. 1, 1961).

Partial waves with $l > 1$ appear in $\pi^- + p \rightarrow \Lambda + K^0$ at the ΣK thresholds. This necessitates a reconsideration of the criteria sufficient to determine the $\Sigma\Lambda$ parity $P(\Sigma\Lambda)$ by the method of cusps. The usual assumption that contributions which show a cusp in either of the differential cross section or the polarization may be ignored beyond some optimal power in $\cos\theta$ is made. On this sole basis, previously stated criteria are rendered inadequate due to the occurrence of Minami and other ambiguities. It is shown that under suitable circumstances there exist unambiguous correlations between certain properties of cross-section cusps and of polarization cusps. These correlations could possibly be of use to determine $P(\Sigma\Lambda)$ and give information as to which states contribute significantly to the ΛK production at ~900 Mev. The finite separation between $\Sigma^0 K^0$ and $\Sigma^- K^+$ thresholds is taken into account. The results are summarized in a table of cusp properties. (auth)

26877 BROKEN SYMMETRIES AND BARE COUPLING CONSTANTS. Murray Gell-Mann and Fredrik Zachariasen (California Inst. of Tech., Pasadena). Phys. Rev., 123: 1065-71(Aug. 1, 1961).

There are known cases of symmetry laws valid for one kind of interaction but broken by another. Each symmetry is then supposed to be exact for bare masses and coupling constants but only approximate for the renormalized quan-

tities, like neutron and proton masses. How the equality of unrenormalized constants can be rephrased as a statement about measurable quantities is discussed. This question is particularly important in connection with proposed strong-interaction symmetries that are supposed to be badly broken. The answer appears to involve the limits of ratios of experimental quantities at very high momenta. First the connection between wave-function renormalizations and weak and electromagnetic form factors is discussed. Then, the measurement of strong-interaction vertex renormalization factors is taken up by the study of scattering amplitudes at energies and momentum transfers large compared to all masses. The last part of the work is based in part on indications from the perturbation development of pseudoscalar meson theory. (auth)

26878 DEUTERONS FROM HIGH-ENERGY PROTON BOMBARDMENT OF MATTER. S. T. Butler and C. A. Pearson (Univ. of Sydney). Phys. Rev. Letters, 7: 69-71 (July 15, 1961).

A model is presented for deuteron production during the high energy nucleon bombardment of nuclei. It is supposed that the high energy nucleon strikes a nucleus, liberating a shower of nucleons whose angular distribution is strongly forward peaked. It is proposed that the deuterons are formed from pairs of shower nucleons that have small relative momenta. Production amplitudes are calculated, for cascade nucleon energies from 60 to > 500 Mev. The bombardment of nuclei by 25 Bev protons is given as an example. (T.F.H.)

26879 POSSIBILITY OF A 4-PION STRUCTURE IN THE T=J=1 PION-PION SCATTERING AMPLITUDE. V. De Alfaro (Instituto Nazionale di Fisica Nucleare, Turin) and B. Vitale. Phys. Rev. Letters, 7: 72-4(July 15, 1961).

The T = J = 1 π-π resonance is considered. It is noted that an enhanced 4π state could cause a structure effect, which could be responsible for discripancies in the observed π-π resonant energies and half widths. The 2π and 3π states are discussed, with regard to their effects on the 4π state. The effects of the proposed 4π resonance on various reactions are discussed. (T.F.H.)

26880 WEAK INTERACTION DECAY OF BARYONS. Kh. Kh. Yiglane (H. Oiglane). Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 13, 87-111(1961). (In Russian)

All known baryons (N, Ξ, Σ, and Λ) are assumed to form a set of particles which can be described by a 32-component spinor equation. The 10-dimensional vector space corresponding to the 32-dimensional spinor space consists of the sum of two subspaces: a 4-dimensional space-time and a 6-dimensional isotopic space. The 3-component isotopic spin vectors are constructed by means of inversion operations in the isotopic space. The wave equation for free baryons is solved by a perturbation procedure. Weak interaction transitions between baryons are described and a quasiempirical equation for baryons in an external electromagnetic field is proposed. Extensive use of Hamiltonian functions is made. (L.N.N.)

26881 POLARIZATION IN THE NUCLEON–DEUTRON SCATTERING. Hsu-dan Shih, Leo-fu Lo, Sin Shu, and Nien-ning Haung (Inner Mongolian Univ.). Wu Li Hsüeh Pao, 16: 325-30(June 1960).

Using invariance in rotation and reflection and time reversal, general formulas for polarization in the nucleon-deuteron scattering were obtained. The consequences are represented in turn of scattering phase shifts. (auth)

26882 THE ANALYZABILITY OF THE SCATTERING AMPLITUDE AND UNITARITY OF THE SCATTERING OPERATOR IN π-π INTERACTION. J. J. Henning (Potchefstroom Univ. for C. H. E., Union of South Africa). Z. Physik, 163: 211-17(1961). (In German)

The limitations which unitarity imposes on the magnitudes of the residues for the scattering amplitude in an effective range treatment of pion-pion scattering are investigated. The conditions $|\lambda_1/m_1(m_1+m)| \leq 4$ and $|\lambda_1/m_1(m_1+m)| \leq 4|m_1+m_2/m_1-m_2|\lambda_2/m_2(m_2+m)| \leq 4|m_1+m_2/m_1-m_2|$ are derived. (auth)

Neutron Physics

26883 (BNL-664) NEUTRON PHYSICS OF AND WITH THE HIGH FLUX BEAM RESEARCH REACTOR. Brookhaven Lecture Series Number 5. Herbert J. C. Kouts (Brookhaven National Lab., Upton, N. Y.). Mar. 15, 1961. 27p.

A review is presented of the evolution of the High Flux Beam Research Reactor and its design and construction. (D.L.C.)

26884 (GA-1721) THE SLOWING-DOWN OF FISSION NEUTRONS IN BERYLLIUM OXIDE. A. J. Goodjohn and J. C. Young (General Atomic Div., General Dynamics Corp., San Diego, Calif.). June 6, 1961. Contract AT(04-3)-187. 24p.

The Fermi age to indium resonance for fission neutrons in beryllium oxide was measured. The experiment involved the measurement of the indium-resonance flux along the axis of a rectangular beryllium oxide stack with a plane fission-neutron source placed near one end. The General Atomic linear accelerator was used to provide the primary neutron current by means of the (γ,n) reaction in uranium and lead and subsequent thermalization in a graphite thermal column. The analysis of the experiment involved the deduction of the infinite second moment from a calculation of the finite moments of the measured distribution. The experimental result was 93.4 cm^2 with an experimental error of ±4%. In order to clarify some of the uncertainties associated with the experiment, a calculation of the age was made using a multigroup P_1 approximation to Boltzmann's equation and the most recent information on fast-neutron cross sections and elastic-scattering angular distributions for beryllium and oxygen. The P_1 result was 91.5 cm^2 ±3%. (auth)

26885 (LAMS-2523) THE TOP CODE. Clarence E. Lee (Los Alamos Scientific Lab., N. Mex.). Aug. 1960. Contract W-7405-Eng-36. 94p.

The TOP code, designed to perform finite cylinder neutron transport theory calculations from a general input tape prepared by other calculations, is described. The transport theory is based upon the difference equations and calculational methods developed in "Numerical Methods for Solving Transient and Steady State Neutron Transport Problems" (LA-2260) and "The DSN and TDC Neutron Transport Codes" (LAMS-2346). (auth)

26886 (LS-97) DELAYED NEUTRONS. An Annotated Bibliography. A. Gralewska (Israel. Atomic Energy Commission, Tel-Aviv). May 1961. 35p.

Included are 98 references to books and U. S. and foreign journals and reports published from 1936 to 1961. The sources of information include NSA 1948 to 1961, Chemical Abstracts 1936 to 1960, Physics Abstracts 1936 to 1960, Scientific Journals 1960 to 1961, books, reports, and bibliographies. Brief abstracts and author index are also included. (P.C.H.)

26887 (NARF-61-29T) MONTE CARLO AIR-SCATTERING DATA FOR MONOENERGETIC FAST NEUTRONS

FROM POINT ISOTROPIC SOURCES. C. A. Diffey (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Aug. 15, 1961. Contract AF33(600)-38946. 80p. (MR-N-284)

The Monte Carlo fast-neutron air-scattering data presented in FZK-9-147, Volumes I and II, were integrated to obtain the angular distributions and energy spectra for a point isotropic source emitting one neutron per second at a given energy E_0. These calculations were performed for source-detector separations of 10, 35, 64, and 100 feet and for initial neutron energies of 0.33, 1.1, 2.7, 4.0, 6.0, 8.0, 10.9, and 14.0 Mev. (auth)

26888 THE MATRIX FORMULATION OF THE TWO-GROUP THEORY FOR THE DIFFUSION OF NEUTRONS. E. Jeltsch (Kernforschungsanlage, Jülich, Ger.). Atomkernenergie, 6: 237-43(June 1961). (In German)

A short description of the matrix method is given in connection with two-group diffusion problems. This treatment is applied to two irradiation facilities. Furthermore, the method is used to derive critical equations for three simple cylindrical reactors. The handling of adjoint fluxes and the treatment of reactors reflected on all sides is to be found in the appendix. The procedure is easy to use in calculations of more complicated arrangements, but it is limited to one-dimensional problems and such for which a product separation is possible. (auth)

26889 SCATTERING OF SUBTHERMAL NEUTRONS OF H_2O, CH_2O_2, AND C_6H_6. Klaus Heinloth (Technische Hochschule, Munich). Z. Physik, 163: 218-29(1961). (In German)

The total cross section of H_2O, CH_2O_2, and C_6H_6 was determined in the range 0.2 to 2.7×10^{-3} ev and at 36×10^{-3} ev as a function of neutron energy and substance temperature. With increasing temperature the total cross section proceeds in monotonously, increasing with step-like discontinuities at the phase transformation points. The step-like increase at the fusion point is limited chiefly through the relaxation of molecular binding. The frequencies of acoustic oscillations were therefore lowered and were consequently excited more, causing an increase of the inelastic scattering cross section. The step-like decrease at the boiling point is principally limited by the elevation of the rotation hindrance of the molecule in the steam. (tr-auth)

Nuclear Properties and Reactions

26890 (AFOSR-1074) A SHAPE-INDEPENDENT THEORY OF HIGH ENERGY NUCLEON-NUCLEON SCATTERING. Louis A. P. Balázs (California. Univ., Berkeley). [1961]. Contract AF 49(638)-327. 44p.

A shape-independent formula for nucleon-nucleon phase shifts, approximately valid over wide energy ranges is derived, assuming only general properties of the wave function and potential. It is found to approximately reproduce the S, P, and D proton-proton phase shifts in the ranges 10-150 Mev and 10-310 Mev with two, or at most three, free parameters per state. A generalization, which includes part or all of the outer potential exactly is derived at the same time. (auth)

26891 (ARL-104) NUCLEAR STATE WAVE FUNCTIONS GENERATED BY PROJECTION OPERATORS. Technical Note No. 52. Jean-Louis Calais (Uppsala Univ. and Florida. Univ., Gainesville). Oct. 1, 1960. Contract AF61(052)-351. 45p.

The complete set of orthogonal states used in nuclear shell-model calculations is generally obtained by group-theoretical methods. It is shown how the projection operator technique provides an alternative method. The advantages and disadvantages of the two methods are discussed and it is pointed out that the projection operator method combines with the anti-symmetry requirement in a more natural way than the vector-coupling method. Finally, illustrative calculations are carried out for the nuclear configuration p^3. (auth)

26892 (CU(PNPL)-206) PROGRESS REPORT [ON NUCLEAR RESEARCH] FOR JULY, AUGUST, SEPTEMBER 1960 TO THE UNITED STATES ATOMIC ENERGY COMMISSION. (Columbia Univ., New York. Pegram Nuclear Physics Labs.). Contract AT-30-1-GEN-72. 54p.

Routine processing of data taken during a run of the slow neutron velocity spectrometer was continued. Work on the 200-meter helium flight tube and the new detector system is continuing. Material is being obtained to construct a slow chopper. A large number of surface solid state detectors are being constructed and studied. The study of the thermal neutron absorption cross section of normal boron standards was completed. Preliminary investigations of the mass distribution of fission fragments in U^{235}, U^{233}, and Pu^{239} using two matched solid state detectors were completed. Initial results on mass distribution curves vs total kinetic energy revealed important trends in symmetric and asymmetric fissions. The work on slow neutron scattering for hydrogen compounds and MnO is being extended to a large number of hydrogenous solids and liquids and to various temperature regions. The precision measurement of the (n,p) cross section at 0.4926 Mev was concluded. Several studies were carried out on (d,n) reactions with O^{18}, C^{13}, Ar^{36}, and F^{19}. Improvements were made in target preparation for experiments in proton scattering from C^{12}. The perturbation type analysis of (He^3,t) reactions applied to a "black" nucleus and a "sharp cut-off" at the nuclear surface was carried out. The He^3 gas handling system was completed. The low field Zeeman transitions were observed in the atomic spectrum of O^{15}. An anti-coincidence detecting system for the cyclotron was completed which cut the cosmic background by a factor of 16 to 18. The Mössbauer effect in Coulomb excitations was investigated. A determination of the frequency dependence of a clock on electrostatic potential was made. A p-n junction transistor doped with phosphorus was used as a beta spectrometer. A Geiger counter was built and tested for use in the beta spectrometer for investigating the monoenergetic positrons in the decay of Bi^{206}. Theoretical studies were made on gamma angular distributions, possible parity and time reversal experiments using the Mössbauer effect, and higher order correction to beta spectral shapes. Three low-noise preamplifiers were designed and constructed. Two modifications were made on the time-of-flight analyzer. A transistor time-to-pulse-height converter was designed. A differential dee voltmeter was constructed for use with the cyclotron. An automatic positioning unit for angular correlation studies is being constructed. (auth)

26893 (JINR-P-234) $\beta-\gamma$-KORRELYATSIYA PRI ZAPRESHCHENNOM β RASPADE ORIENTIROVANNYKH YADER. ($\beta-\gamma$ Correlation in Forbidden β Decay of Oriented Nuclei). G. V. Efimov (Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1958. 51p.

A formula derived for an electron wave function, considering Coulomb field for large and small Z, was used for describing the β decay Hamiltonian for arbitrary order transition forbiddeness. The angular correlations are cal-

culated on the basis of density matrix statistical decay transformations. The Levinson method, tensor spherical operators and generalized spherical harmonics, was utilized in developing an expression for $\beta-\gamma$ correlation, considering the polarization in β-active nuclei in an arbitrary transition forbiddeness where the angular part and squared combinations of interaction constants are evolved. (tr-auth)

26894 (LAMS-2574) PLUTONIUM-240 CROSS SECTIONS AND THEIR TEMPERATURE DEPENDENCE. Joseph J. Devaney and Leona Bordwell (Los Alamos Scientific Lab., N. Mex.). June 1961. Contract W-7405-ENG-36. 43p.

A Breit-Wigner analysis of Pu^{240} was folded into a Maxwellian velocity distribution to obtain total, scattering, radiative capture, and a porton of the fission cross sections versus neutron energy from 0.0253 to 120 ev and for Pu^{240} temperatures of 0.0253 to 0.2 ev. (auth)

26895 (NARF-60-16T(Add.1)) ARGON ACTIVATION EXPERIMENT. Addendum 1. D. G. Anderson (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). July 24, 1961. Contract AF 33(600)-38946. 19p. (MR-N-260-1)

Additional irradiated argon measurements for the Aircraft Shield Test Reactor (ASTR) and results of the initial studies on the exhaust effluent from the dry-pool environment of the 3-Mw Ground Test Reactor (GTR) are reported as an addendum to NARF-60-16T. With the ASTR in the 2π geometry of Configuration II, no detectable amounts of argon-41 were present in the air above the reactor at a power level of 2 Mw. With the GTR in the irradiation closet of Configuration III (4-inch water reflector), an argon activity of 0.5×10^{-10} μc/cc-watt was generated in the dry side of the pool. (D.L.C.)

26896 (NP-10436) THE HIGH FREQUENCY LIMIT OF 15.1 MEV BREMSSTRAHLUNG. Technical Report No. 26. H. E. Hall and A. O. Hanson (Illinois. Univ., Urbana. Physical Research Lab.). June 1961. Contract ONR 1834 (05). 111p.

A thesis submitted by H. E. Hall.

The 15.1-Mev scattering resonance in carbon is used to study the yield of photons at the high-frequency limit of the bremsstrahlung spectrum. A survey of the yield from several elements was carried out at 0° where the yield at the limit increased strongly with the atomic number. The yield in the forward direction is strongly dependent on the effective target thickness and is, therefore, difficult to interpret. More detailed measurement of the 15.1-Mev isochromats from a thin thorium (Z = 90) target at several angles are presented and compared with the available calculation; a value of 1.61 ± 0.16 mb is obtained for the total cross section at the tip. This is in reasonable agreement with a theoretical value of 1.96 ± 0.38 mb based on the inverse photoeffect and 1.2 mb as obtained by a direct evaluation in the extreme relativistic limit. (auth)

26897 (NP-10536) AN INVESTIGATION OF SOME (t,d) REACTIONS IN LIGHT NUCLEI AT 5.5 MEV. P. D. Forsyth, A. A. Jaffe, I. J. Taylor, and F. de S. Barros (Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas). 1961. 26p. (Notas de Física, Vol. VII, No. 4, p.47-71).

A broad range magnetic spectrograph was used to analyze the deuterons emitted from targets of natural boron, carbon, silicon dioxide, and aluminum bombarded with 5.5-Mev tritons. The angular distributions of the majority of the deuteron groups from the reactions observed in B^{10}, C^{12}, C^{13}, O^{16}, Al^{27}, and Si^{28} were measured and information was also obtained on (t,d) reactions in Mg^{24}, Si^{28}, and Ca^{40} because of the presence of these nuclei as impurities in the targets. In all cases, the measured excitations of the final nuclei are in good agreement with the accepted values. The angular distributions were compared with the stripping theory and also with published data on (d,p) transitions between the same initial and final nuclear states. Where possible, the ratios of the yields of corresponding (t,d) and (d,p) reactions were compared with the predictions of stripping theory; these results show marked deviations from those of previous comparisons between (d,t) and (d,p) reactions. (auth)

26898 (UCRL-6278-T(Rev.)) NUCLEAR MEASUREMENTS RELATED TO ASTROPHYSICAL PROCESSES. W. A. S. Lamb (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 31, 1961. 25p.

Various proton reactions from which stars derive energy are studied. Included are $C^{12}(P,\gamma)N^{13}$, $N^{14}(P,\gamma)O^{15}(\beta^+\nu)N^{15}$, $O^{16}(P,\gamma)F^{17}$, and $C^{13}(P,\gamma)N^{14}$ reactions. (J.R.D.)

26899 (UCRL-6443) MEASUREMENT OF THE POLARIZATION OF PHOTONEUTRONS FROM DEUTERIUM. Frederick V. Martin and Walter John, Jr. (California Univ., Livermore. Lawrence Radiation Lab.). May 12, 1961. Contract W-7405-eng-48. 40p.

Thesis submitted by Frederick V. Martin.

The polarization of the neutrons produced by photodisintegration of deuterium by 2.75-Mev gamma rays was measured and the results compared to theoretical predictions. The photoneutrons were taken at five gamma-ray-neutron angles between 45 and 135° in the laboratory and scattered from magnesium which has a broad resonance at these neutron energies. The polarization was determined from the asymmetry in the left-right scattering from magnesium. The neutrons are found to be negatively polarized as predicted. The magnitude of the polarization and the dependence on the gamma-ray-neutron angle were found to be in agreement with the theory within experimental error. (auth)

26900 (UCRL-9650) HEAVY-ION ELASTIC SCATTERING (thesis). Jonas Alster (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 17, 1961. Contract W-7405-eng-48. 91p.

The elastic scattering of C^{12} ions from Ar, Fe, Ni, Ag^{107}, In, and Ta was measured as a function of angle, at a laboratory-system energy of 124.5 Mev with the Berkeley heavy-ion linear accelerator. The experimental equipment and techniques are discussed. The angular distributions show the same general behavior as previous heavy-ion elastic scattering experiments. The experimental data were analyzed with the semiclassical Blair model as modified by McIntyre. Very good agreement with experiment was obtained. The measurements were taken with 1% statistics in order to study the structure of the angular distributions in greater detail, because only by fitting the details in the structure was it possible to obtain unambiguous sets of parameters. The parameters indicated a nuclear radius of $1.45A^{1/3} \times 10^{-13}$ cm, and a nearly constant surface thickness of 1.6×10^{-13} cm. Total reaction cross sections were obtained. A rainbow-model analysis by Goldman of the data is given. Existing α- and heavy-ion scattering data were analyzed with the McIntyre model and compared with previous optical-model analyses of the same data. It was found that, by independent analysis, the two models give the same imaginary phase shifts for all partial waves. The real phase shifts are identical above a certain lth partial wave, but differ widely below this l value. It is shown that in the region of disagreement the real part of the phase shifts is irrelevant to the calculation of the cross section. (auth)

26901 (UCRL-9714) TWO-NUCLEON TRANSFER REACTIONS IN THE LIGHT ELEMENTS (thesis). Joseph

Cerny, III (California. Univ., Berkeley. Lawrence Radiation Lab.). May 23, 1961. Contract W-7405-eng-48. 107p.

The α,d reactions in the light elements were investigated in an attempt to determine their usefulness as spectroscopic probes. Deuteron energy spectra from the $Li^6(\alpha,d)Be^8$, $Li^7(\alpha,d)Be^9$, $C^{12}(\alpha,d)N^{14}$, $N^{14}(\alpha,d)O^{16}$, and $N^{15}(\alpha,d)O^{17}$ reactions were measured and angular distributions are given for deuteron groups arising from the formation of resolvable final states. Selection rules for two-nucleon transfer reactions are discussed. Direct-reaction α,d or d,α transitions between 0+, T = 0 and 0+, T = 1 states are shown to involve difficulties with angular momentum and parity conservation in addition to requiring nonconservation of isotopic spin. The unobserved $C^{12}(\alpha,d)N^{14*}$(2.31-Mev) transition is interpreted from this point of view. Marked variation in the relative cross sections of final states was observed in most of the deuteron spectra. Some evidence was obtained that the captured nucleons prefer to enter equivalent shell-model levels and, lacking that, adjacent levels. No final states definitely known to involve more than two excited nucleons were observably populated; however, very few states of this nature were theoretically established. Glendenning's two-nucleon stripping theory was applied to the deuteron angular distributions, and several excellent fits were obtained. The fits, in general, showed little dependence on the nature of the final nuclear configuration when several were reasonable, so that no spectroscopic identification of final states appeared to be possible at these high-momentum transfers. Angular distribution fits using Butler theory are shown for comparison. (auth)

26902 (UCRL-9747) NUCLEAR ORIENTATION OF SOME RARE-EARTH ISOTOPES (thesis). Carolyn Ann Lovejoy (California. Univ., Berkeley. Lawrence Radiation Lab.). June 1961. Contract W-7405-eng-48. 52p.

Nuclear orientation experiments were performed on five isotopes, Pm^{143}, Tb^{156}, Tb^{161}, Ho^{160}, and Sm^{153}, in crystals of $Nd(C_2H_5SO_4)_3 \cdot 9H_2O$. The angular distribution of the 740-kev γ ray of Nd^{143} was found to be $W(\theta) = 1 - (0.060 \pm 0.006) P_2(\cos\theta)$ at 0.02°K. Values for the mixing ratio, δ, of the 740-kev γ ray of Nd^{143} were obtained as a function of the magnetic moment of the ground state of Pm^{143} for ground state spins of $^5/_2$ and $^7/_2$. The spin of the excited state of Nd^{143} was assigned as $^9/_2$-. An absolute lower limit of $|\mu| > 1.0$ was set on the magnetic moment of Pm^{143}. The mixing ratio of the 740-kev γ ray was found to lie in the range $0.23 \leq (E2/M1) \leq 0.35$ if the ground state spin is $^7/_2$ and in the range $0.255 \geq (E2/M1) \geq 0.217$ if the ground state spin is $^5/_2$. The spin of the 2042-kev level in Gd^{156} populated by the decay of Tb^{156} was assigned as 4 and the spin of the 1620-kev level was assigned as 5+. The electron capture decay to both the 2042-kev level and the 1931-kev level was found to be mainly L = 1. If the ground-state spin of Tb^{156} is 3 the nuclear magnetic moment was found to be $\mu = 1.45 \pm 0.06$ and the nuclear quadrupole moment, $Q = 1.40 \pm 0.16$. Mixing ratios of the γ rays were determined. The angular distribution of the 1417-kev γ ray was found to be $W(\theta) = 1 - (0.206 \pm 0.016) P_2(\cos\theta)$ at $1/t = 58.5$. Explanations are advanced for the failure of Tb^{161}, Ho^{160}, and Sm^{153} to show a noticeable anisotropy at temperatures of around 0.02°K. (auth)

26903 (AFCRL-TN-60-1170) THE INVERSE PROBLEM IN THE QUANTUM THEORY OF SCATTERING. L. D. Faddeev (Faddeyev). Translated by B. Seckler for New York Univ. from Uspekhi Mat. Nauk, 14: No. 4, 57-(?) (1959). 106p. (AD-254856; EM-165)

A survey was made of the following fundamental problem arising in the quantum theory of scattering: the solution of the equation satisfying $L\psi = -(d^2/dx^2)\psi(x,k) + q(x)\psi(x,k) = k^2\psi(x,k)$, $\psi(0,k) = 0$ behaves asymptotically like $\psi(x,k) \approx C(k) \sin(kx - \eta(k))$, provided the potential q(x) decreases sufficiently fast as x tends to infinity and to determine to what extent assigning the function $\eta(k)$ determines q(x) and how they are related. Topics covered include the expansion theorem, asymptotic behavior of the solution of the Schroedinger equation for large time, transformation operators, existence of a solution for the Gelfand-Levitan equation, Marchenko's equation, Krein's equation, relationship of the operators to the discrete spectra, operators with M-functions differing by a rational factor, and transformation of Sturm-Liouville type equations. (M.C.G.)

26904 (UCRL-Trans-526(L)) THE RAYLEIGH AND RAMAN SCATTERING. G. Placzek. Translated by Ann Werbin for Univ. of California from Handbuch der Radiologie. Band VI. Teil 2. Quantenmechanik der Materie und Strahlung. 2nd edition, 209-374(1934). 206p.

A study of the Raman effect of isolated systems, atoms, and molecules is presented. The following topics are covered: the quantum theory of scattering, the correspondence theory of the scattering phenomenon, Dirac's scattering theory, the general scattering equation, the scattering equation for random systems, resonance processes, scattering processes and thermal equilibrium, the harmonic oscillator, the free electron, energy levels and selection rules, undisplaced scattered radiation, displaced scattered radiation, the polarizability theory, application of the polarizability theory, Rayleigh scattering and the vibrational Raman effect, fundamental concepts of the symmetry theory, the vibrational Raman effect and molecular symmetry, simple vibrational spectra, vibrational spectra of perturbed systems, rotational structure, fine structure of the scattered radiation, scattering spectra and intermolecular force fields, experimental results and the polarizability tensor, and phenomena excluded by the polarizability theory. (M.C.G.)

26905 (UCRL-Trans-692) THE MASS SPECTRUM OF THE UNCHARGED FRAGMENTS FROM ELECTRON BOMBARDMENT OF MOLECULES. D. Beck and O. Osberghaus. Translated for Univ. of California from Z. Physik, 160: 406-19(1960). 5p.

By the irradiation of molecules in the gas phase (10^{-6}mm) with electrons(200 ev) ionized and neutral fragments were produced. The neutral fragments could be ionized by a second electron beam and detected mass spectrometrically. Appearance potentials and mass numbers suffice in many cases for identification. The hydrocarbons propane and hexane were investigated. From propane, an almost complete qualitative and quantitative analysis of the neutral products was possible, so that in analogy to the normal mass spectrum of the ions, a "neutral spectrum" of the uncharged fragments can be given. (auth)

26906 TWO-BODY POTENTIALS AND EXCITED STATES OF NUCLEI. [PART] II. P. Tarjanne (Inst. of Tech., Helsinki). Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 74, 1-12(1961). (In English)

The $J = 0^+ - 2^+ - 4^+$ and $J = 0^+ - 2^+ - 2^+$ spin parity schemes of nuclei in the intermediate mass region $40 < A < 140$ were investigated, a modified Signell-Marshak potential and Moshinsky's momentum series method being used in the calculation of the matrix elements. The classification of about 60 excited states of more than 30 nuclides were thus quantitatively verified. Proceeding to odd nuclei, their j-doublet splittings were calculated from the same potentials. Two different methods give fair absolute agreement and good relative agreement with the experimental data avail-

able. Finally some integrals useful in explicit calculations of nuclear spectra were tabulated. (auth)

26907 TOTAL CROSS SECTION OF VANADIUM AS A FUNCTION OF TEMPERATURE. Pierre Denis (Centre d'Etudes nucleaires, Grenoble, France) and Dominique Roux. Arch. sci. (Geneva), 13: 574(Oct.-Dec. 1960). (In French)

The total cross section of vanadium as a function of temperature was measured with a NaCl crystal spectrometer. At 0.0253 ev the values $\sigma_{tot} = 9.96 \pm 0.33$ b at 22°C and $\sigma_{tot} = 10.34 \pm 0.30$ b at 620°C were obtained by taking into consideration the thermal expansion of the sample. (J.S.R.)

26908 THE SPECTRUM OF NEUTRONS FROM THE IRRADIATION OF URANIUM BY 14-MEV NEUTRONS. R. L. Clarke (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 957-66(July 1961). (AECL-1240)

The spectrum and absolute yield of neutrons resulting from 14-Mev neutrons incident on natural uranium was observed at 90° ± 16 to the incident neutron beam by a time-of-flight method. Further observations of the spectrum from 9 to 13.5 Mev were made for scattering angles at 30 and 60°. In addition to the expected neutrons resulting from evaporation and fission, strong evidence is seen for direct interaction inelastic scattering. The (n,n') cross section is estimated to be 150 ± 70 millibarns. (auth)

26909 NEUTRON EVAPORATION IN THE 14-MEV NEUTRON FISSION OF URANIUM. G. C. Hanna and R. L. Clarke (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 967-75(July 1961). (AECL-1241)

The numbers of prefission and postfission neutrons expected from the 14-Mev neutron fission of uranium have been calculated from the experimental data on partial cross sections and neutron multiplicities. It has been assumed that the competition between neutron emission and fission does not change with increasing energy beyond threshold. The neutron energy spectrum measured recently by Clarke gives a smaller intensity in the energy range 4–6 Mev than is expected from the calculated number of postfission neutrons. The measured intensity suggests that only 2.1 ± 0.5 neutrons are evaporated from the moving fission fragments. (auth)

26910 THE K-LL AUGER SPECTRUM OF $_{66}Dy^{161}$. Robert L. Graham and Janet S. Merritt (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1058-64(July 1961). (AECL-1263)

The K-LL Auger spectrum Dy^{161} has been studied using the Chalk River iron-free β spectrometer at an instrumental resolution of ~0.07%. After correcting for the estimated intensity of the L_3 43.81-kev conversion line (96% M1 + 4% E2), which coincides with the second ($K\text{-}L_1L_2$) Auger line, the following energies (kev) and intensities are obtained: 35.492, 1.00; 35.963, 1.31; 36.369, 0.22; 36.732, 0.83; 36.806, 0.28; 37.195, 2.39; 38.002, 1.07. The energies are from 20 to 50 ev higher than the non-relativistic predictions. The relative intensities are consistent with experimental results at other atomic numbers. (auth)

26911 ANGULAR VARIATION OF AXIAL SPIN-HAMILTONIAN EIGENVALUES IN STRONG MAGNETIC FIELD. H. A. Buckmaster (Univ. of Alberta, Calgary). Can. J. Phys., 39: 1073-9(July 1961).

Tables of eigenvalues and matrix elements of transition probabilities were calculated for chromium in ruby, i.e., for $S = 3/2$ in an axial crystalline electric field. The terms in the expressions for the eigenvalues of an axial spin-Hamiltonian can be tabulated for the most common values of spin, facilitating the calculation of the eigenvalues. (L.N.N.)

26912 THE 1.2-MEV BETA DECAY OF I^{128}. K. G. McNeill and J. D. Prentice (Univ. of Toronto). Can. J. Phys., 39: 1080-2(July 1961).

By observing the beta spectrum of iodine-128 in coincidence with the 0.98 Mev gamma ray, a derivation of 1.14 Mev for the maximum energy of the weak lower-energy group from the Curie plot was confirmed. A NaI(Tl) crystal, irradiated with neutrons, was used as both source and detector for the beta particles. The Curie plot of the spectrum had a straight line shape and intercepted the energy axis at 1.20 Mev. (L.N.N.)

26913 THE K-LL AUGER SPECTRUM OF $_{55}Cs^{133}$. R. L. Graham, F. Brown, G. T. Ewan, and J. Uhler (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1086-9(July 1961).

Measurements of the K-LL Auger lines were made to test the nonrelativistic theory of Asaad and Bishop (1958) at the lowest value of the atomic number. The source material, xenon-133, was prepared by neutron irradiation of natural xenon for six days in the NRU Reactor. The energies and relative intensities are summarized in tabular form; some results are similar to those found previously. Others seemed to indicate two additional satellite lines. The absolute coefficient for K-LL Auger yield can be deduced from the data. (L.N.N.)

26914 THE LIFETIME OF THE 6.25-KEV LEVEL IN Ta^{181}. M. A. Clark (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1090(July 1961). (AECL-1268)

The 6.25 kev electric dipole transition in tantalum was observed and the level lifetime was measured. A source of tungsten-181 was prepared by employing 10-Mev protons from the Chalk River Tandem Accelerator to initiate the (p,n) reaction. The average value for the half life, obtained through two different methods, was $6.8 \pm 0.4 \times 10^{-6}$ sec. (L.N.N.)

26915 A METHOD FOR THE DETERMINATION OF THE SPIN OF THE COMPOUND NUCLEUS IN THE DIFFUSION OF NEUTRONS BY POLARIZED NUCLEI. Pierre-Gilles de Gennes. Compt. rend., 252: 3571-3 (June 5, 1961). (In French)

In a target formed by a magnetic material, there exists at low temperatures a crossed term between the nuclear resonating diffusion and the magnetic diffusion of the neutrons. This term permits, in favorable cases, the determination of the spin of the compound nucleus without utilization of polarized neutrons. (tr-auth)

26916 DECAY OF A METASTABLE STATE OF PROTACTINIUM-233. Adrien Marchal and Pierre Yvon. Compt. rend., 252: 3774-5(June 12, 1961). (In French)

It was verified that the decay of Pa^{233} comes from the 87-kev energy level. The measurements were repeated with a time-amplitude converter. The value found ($36.0 \pm 0.5 \times 10^{-9}$ sec) is in agreement with preceding result. (tr-auth)

26917 EMISSION REACTIONS OF HELIUM-3 PRODUCED BY 43-MEV α PARTICLES ON ISOTOPES OF IRON, NICKEL, AND COPPER. Jean Saudinos, René Beurtey, Philippe Catillon, Robert Chaminade, Monique Crut, Henriette Faraggi, André Papineau, and Jacques Thirion. Compt. rend., 252: 3776-8(June 12, 1961). (In French)

$X^A(\alpha,He^3)X^{A+1}$ reactions were studied on the nuclei Fe^{56}, Fe^{57}, Ni^{58}, Ni^{60}, Ni^{64}, Cu^{63}, and Cu^{65}. The excitations of some levels or groups of levels in the residual nuclei were

verified. The angular distributions of He^3 in the case of $Fe^{56}(\alpha,He^3)Fe^{57}$ are strongly directed toward the rear. (tr-auth)

26918 MEASUREMENT OF THE ABSORPTION CROSS SECTION OF NATURAL NEON FOR THERMAL NEUTRONS. Jean-Claude Carré, Michel Robin, and René Vidal. Compt. rend., 252: 3973-5(June 19, 1961). (In French)

The cross section of natural neon was measured in a flux of thermal neutrons by the phase oscillation method in the Zoë Reactor. The capture of the neon was compared with that of nitrogen, the effect of the scattering being corrected by comparison with hydrogen. The absorption cross section of natural neon for neutrons at 2200 m/sec is found to be 32 ± 9 mb. (tr-auth)

26919 THE DECAY PERIOD OF Zn^{65}. Ion I. Agribiceanu and Vasile Tatu (Inst. of Atomic Physics, Bucharest). Compt. rend., 252: 3979(June 19, 1961). (In French)

A spectrographic method was used to measure the half life of Zn^{65}. The intensity of the Zn radiations of 3345.02, 3302.94, and 3282.33 Å was followed for ten months with respect to the closest radiations of Cu. The half life determined from these measurements was $T_{\frac{1}{2}} = 249.7 \pm 1.4$ days. This value is compared with that obtained by other methods. (J.S.R.)

26920 FRAGMENTATION OF LIGHT NUCLEI. M. M. Makarov and N. A. Perfilov (Khlopin Radium Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 579-80(May 21, 1961). (In Russian)

Cyclotron protons with energies of 100, 200 and 350 Mev were used to irradiate P-9 (g) nuclear photoemulsions which were analyzed for tracks of multicharged particles. The results show that 1) the cross-sections for the formation of fragments having a charge $Z \geq 4$ and a range $1 \geq 15\ \mu$ from C, N, and O nuclei are equal to 0.50 ± 0.34, 0.92 ± 0.54 and 60 ± 0.38 mbarns for 100-, 200-, and 300-Mev protons respectively, 2) that the most probable range is the same for 100- and 200-Mev protons, 3) that all the fragments are directed toward the front part of the hemisphere with respect of the direction of the proton beam; the smaller the proton energy, the more evident is this forward distribution; and 4) that there is a significant contribution of cascade protons at angles > 120°. It is assumed that a nuclear cascade does not always originate from a nucleon-nucleon collision, but that the appearance of fragments can be the result of quasielastic scattering of protons originating in the process of the development of a cascade on the sub-structural units of the nucleus. It is pointed out that the probability of interaction with the sub-structural units decreases with increasing proton energies (above 100 Mev). (TTT)

26921 K-CONVERSION COEFFICIENT OF THE ISOMERIC TRANSITION OF Nb^{94m}. L. Ciuffolotti (CESNEF, Milan), C. Giori, and M. Mandelli Bettoni. Energia nucleare (Milan), 8: 422-4(June 1961). (In English)

The γ transition Nb^{94m}(41.5 kev) → Nb^{94} (ground state) has a half life of 6.6 min., and is almost completely internally converted. The K-conversion coefficient is measured to be 840 ± 6%. The transition may be interpreted as having either an M3 or an E3 nature. (T.F.H.)

26922 POLARIZATION OF ELASTICALLY SCATTERED 3.4-MeV NEUTRONS. Frank L. Hereford (Univ. of Virginia, Charlottesville). Helv. Phys. Acta, Suppl. VI, 6, 303-10 (1961). (In English)

The polarization of 3.4 Mev neutrons elastically scattered by sulfur, copper, and zinc is measured. A by-product of the experiment is a considerable amount of data on the polarization of neutrons scattered by carbon. Differential cross sections are also given for these elements at 3.7 Mev as obtained by Machwe, Kent, and Snowden. It is shown from these measurements that the suitability of optical model descriptions of the elastic scattering of nucleons by nuclei is not very good. (N.W.R.)

26923 THE NEUTRON-DEFICIENT CHAIN ^{80}Sr-^{80}Rb. R. W. Hoff, J. M. Hollander, and M. C. Michel (Univ. of California, Livermore and Berkeley). J. Inorg. & Nuclear Chem., 18: 1-7(Mar. 1961). (In English)

The new neutron-deficient pair Sr^{80}–Rb^{80} has been identified from irradiations of Ga_2O_3 targets with 133-Mev nitrogen ions. Sr^{80} decays with a half life of 100 ± 6 min to 34 ± 4 sec Rb^{80}, a genetic relationship verified by rapid chemical separation procedures. The mass number of Rb^{80} was determined with a time-of-flight isotope separator. Rb^{80} decays primarily (~60 per cent) to the ground state of Kr^{80} with emission of a positron spectrum of E_{max} 4.1 ± 0.5 Mev, and the 620-kev first excited state of Kr^{80} is populated to the extent of ~40 per cent. On the basis of its decay properties, the ground state configuration of Rb^{80} is apparently (1+). The only photon assigned to the decay of Sr^{80} has an energy of 580 kev. (auth)

26924 CALORIMETRIC DETERMINATION OF THE HALF-LIFE OF PROTACTINIUM-231. H. W. Kirby (Mound Lab., Monsanto Chemical Co., Miamisburg, Ohio). J. Inorg. & Nuclear Chem., 18: 8-12(Mar. 1961). (In English)

The heat output of a one-half gram sample of Pa_2O_5 was measured. The half life of Pa^{23} is found to be 32,480 ± 260 years. (auth)

26925 RADIOACTIVE DECAY OF ^{49}Sc. I. Rezanka, J. Frana, M. Vobecky, and A. Mastalka (Nuclear Research Inst., Czechoslovak Academy of Sciences, Prague). J. Inorg. & Nuclear Chem., 18: 13-18(Mar. 1961). (In English)

The radioactive isotope Sc^{49} was isolated from neutron-irradiated natural calcium in a carrier-free form by means of chromatographic separation. It was found to decay with a half life of 57.5 ± 0.1 min mainly by 2010 ± 5 kev β-transition to the ground state of Ti^{49}. A γ-line of 1780 ± 40 kev was observed, indicating the presence of a soft beta component with transition energy of 230 kev and 0.03 per cent intensity. For the 1780-kev level the spin $\frac{5}{2}$ was proposed. (auth)

26926 LOW ENERGY GAMMA TRANSITIONS AND AUGER ELECTRONS FROM THE DECAY $Mo^{99} \rightarrow Tc^{99}$. J. Ravier, P. Marguin, and A. Moussa (Institut de Physique Nucleaire, Lyon). J. phys. radium, 22: 249-56(May 1961). (In French)

Low-energy gamma-transitions from the decay $Mo^{99} \rightarrow Tc^{99}$ were studied by internal and external conversion, in order to verify some features of the disintegration scheme. The K fluorescence yield and the relative intensities of K Auger subgroups were determined. (auth)

26927 ANGULAR DISTRIBUTION OF THE REACTION $Li^6(p,\alpha)He^3$ FROM 100 TO 300 KEV. N'Guyen Huu Khanh, L. Goldman, R. Bouchez (Université, Grenoble, France and Commissariat à l'Énergie Atomique, Grenoble, France). J. phys. radium, 22: 267-70(May 1961). (In French)

The angular distribution of He^3-particles from the $Li^6(p,\alpha)He^3$ reaction was measured below 300 kev. The distribution obtained $I(\theta) \simeq 1 + A \cos\theta$ (with $A \simeq 0.25$) beyond 60° gives preferentially an emission in the forward direction. The compound nucleus theory with two interfering levels (3/2+ at 1.5 Mev and 5/2– at 1.85 Mev) does not

explain the angular distribution observed; a direct interaction process (pick-up) seems to take place at such a low proton energy. (auth)

26928 ANGULAR CORRELATIONS IN Ra^{223} (AcX). F. Bragança Gil, R. Foucher, and G. Y. Petit (Institut du Radium, Orsay, France). J. phys. radium, 22: 289-94 (May 1961). (In French)

Angular correlations between γ rays of 236 and 50 kev of Ra^{223} are measured in solid and liquid sources of various viscosities. The 236-kev γ ray is $E_1 + M_2$ with $3.6 \pm 2.4 \times 10^{-4}$ M_2; $Q_{\frac{1}{2}}$ [50 kev excited state] ≈ 0.28 Q_{2+} [84 kev excited state of Ra^{224}]. Values of the spins of 0, 50, and 286 kev excited states are analyzed, and the value of axial quadrupolar deformation in Ra^{223} is discussed. (auth)

26929 POLARIZATION OF 0.3 TO 1.4 Mev NEUTRONS SCATTERED BY COPPER, ZINC, MOLYBDENUM AND CADMIUM. D. Brown, A. T. G. Ferguson, and R. E. White (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 25: 604-10(1961). (In English)

Measurements were made of the polarization of 0.5 to 1.5 Mev neutrons elastically scattered by Cu, Zn, Mo, and Cd at 55° and Cu and Mo at 90°. Marked departures are found between the results obtained and the predictions of optical model calculations including a real spin-orbit potential. (auth)

26930 MAGNETIC DIPOLE MOMENTS OF ODD-MASS NUCLEI IN THE SPHERICAL REGION. N. Freed and L. S. Kisslinger (Western Reserve Univ., Cleveland). Nuclear Phys., 25: 611-23(1961). (In English)

The magnetic dipole moments of odd-mass nuclei are calculated and compared to the experimental data for nuclei with particles in the 28-126 shells, except for the deformed region of $150 \leqq A \leqq 190$. The wave functions upon which the calculation is based are admixtures of seniority-one wave functions produced by a pairing interaction and obtained by projecting eigenfunctions of the number operator out of Bardeen-type wave functions. Perturbation theory is used to compute the seniority-three admixtures produced by a delta-function residual interaction. (auth)

26931 ON THE PREPONDERANCE OF PROLATE DEFORMATIONS IN NUCLEI. Richard H. Lemmer and Victor F. Weisskopf (Massachusetts Inst. of Tech., Cambridge). Nuclear Phys., 25: 624-33(1961). (In English)

The level scheme of the Nilsson potential is used to calculate the total energy as a function of deformation: the predicted equilibrium deformations can be found as a function of mass number and are in agreement with experiment both in magnitude and shape, i.e., the preponderance of prolate nuclear shapes is produced. The success of a simple Nilsson-type model and the aspect of the potential that makes the prolate deformations more stable are discussed. (L.N.N.)

26932 PROTON SCATTERING FROM LIGHT ELEMENTS AT 142 Mev. A. E. Taylor and E. Wood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 25: 642-55(1961). (In English)

Measurements have been made of the elastic scattering and total cross section of Be, C, N, O, and Al for 142 Mev protons, and the results have been compared with neutron measurements at about the same energy. A simple modification of the original optical model of Fernbach, Serber and Taylor has been found sufficient to explain the proton scattering results, especially in the region of the Coulomb-nuclear interference where the results are sensitive to the choice of the real part of the potential. The addition of spin dependent scattering amplitudes improves the fits to the cross-section data as well as giving fits to polarization measurements. (auth)

26933 PAIRINGS IN THE SHELL MODEL. [PART] II. Minoru Umezawa (Université, Strasbourg). Nuclear Phys., 25: 661-73(1961). (In English)

Coupling schemes are explained for a system of nucleons interacting with each other through a singlet-pairing force in addition to a strong spin-orbit force. Results are applied in particular to ground states of nuclei with $n = 4j_+ + 1$, that is, B^{11} and Al^{27}. Assuming a strong spin-orbit force, it is found that the effect of the pairing force in mixing the spin-orbit partners in a j-j coupling scheme is comparatively large near closure of the j-j subshells. The ratio V_{ol}/V^0 of the depths of the pairing force and spin-orbit force is chosen for each nucleus so that the deviation of the nuclear magnetic moment from the j-j limit would be explained by the competition of the two forces. It is found that such a ratio becomes relatively larger as the nucleus becomes heavier irrespective of the parity of the orbital state of the individual nucleon. (auth)

26934 PAIRING PLUS QUADRUPOLE FORCE MODEL FOR ODD-MASS SINGLE CLOSED SHELL NUCLEI. Raymond A. Sorensen (Columbia Univ., New York). Nuclear Phys., 25: 674-86(1961). (In English)

An intermediate coupling calculation is performed for odd-mass nuclei with the neutrons or protons at a closed shell. The Hamiltonian, an adiabatic approximation to the pairing force plus quadrupole Hamiltonian, is diagonalized to include all states containing up to two phonons of quadrupole vibration. The validity of the approximations is discussed. The level energies and wave functions resulting from the calculation are compared with experimental results and with previously published results. (NSA 14: 26292). (auth)

26935 INELASTIC SCATTERING OF HIGH ENERGY PROTONS AND LEVELS OF NUCLEI. Yoshiyuki Sakamoto (Kyoto Univ.). Nuclear Phys., 25: 687-97(1961). (In English)

The high energy protons scattered from some levels of nuclei are accounted for by means of the radiative widths or lifetimes of the levels without using the wave functions of the ground and excited states of nuclei. The inelastically scattered protons at high energies give information on the spin, parity and isobaric spin values for the levels. Some levels of C^{12} are considered as examples. (auth)

26936 A MODEL OF α-DECAY CONSISTENT WITH α-REACTIONS. J. Osada, D. R. de Oliveira, N. Martins, and T. Miyazima (Instituto de Física Teórica, São Paulo, Brazil). Nuovo cimento (10), 20: 845-56(June 1, 1961). (In English)

A new model of α decay is presented which is consistent with such α reactions as (p,α). Both the α decay and the direct α reaction suggest that with a certain probability α particles exist in the nuclear surface. According to the current theories of α decay the α formation probability is of the order of 10^{-4} while, from the analysis of (p,α) reactions, the α probability is estimated to be several times 0.1. Although there may be some difference in the physical meanings of the α probabilities in the two cases, there are enough reasons to believe they are of the same order of magnitude. In this model α particles are assumed to be constantly formed within the nuclear matter and to go out into the nuclear surface where most of them are reflected back or destroyed and some of them go out into the outer space. Besides this specific mechanism, experimental data were used to solve the above mentioned discrepancy and to explain some systematic tendencies in the α decay isotopes on a unified basis. (auth)

26937 (n,α) AND (n,p) REACTIONS IN CsI CRYSTAL WITH 14 MEV NEUTRONS. G. M. Marcazzan, E. Menichella Saetta, and F. Tonolini (CISE, Milan). Nuovo cimento (10), 20: 903-13(June 1, 1961). (In English)

The energy spectra of α and of protons emitted in (n,α) and (n,p) reactions of 14 Mev neutrons on a CsI(Tl) crystal are presented. These spectra were obtained by employing a new method of mass discrimination to distinguish different particles in the CsI(Tl) crystal. Total cross section values for (n,α) reactions were also obtained. (auth)

26938 ANGULAR DISTRIBUTION OF PROTONS FROM THE REACTION $Si^{28}(n,p)Al^{28}$. L. Colli (CISE, Milan and Università, Milan), G. M. Marcazzan, F. Merzari, P. G. Sona, and P. Tomaš. Nuovo cimento (10), 20: 928-35 (June 1, 1961). (In English)

Angular distribution of protons emitted in the reaction $Si^{28}(n,p)Al^{28}$ is presented. The energy spectrum contains four peaks, which have an anisotropic component superposed to an isotropic part, that is predominant at low proton energy. The analysis of the anisotropic part shows that it can be described with sufficient approximation by means of a direct interaction mechanism; the angular distribution shape can be correlated with the values of the shell model orbits involved in the process of capture and emission of interacting particles. (auth)

26939 INTERACTION OF HIGH ENERGY PROTONS FROM THE CERN PROTON SYNCHROTRON WITH PHOTOGRAPHIC EMULSION NUCLEI. C. Bricman (Université Libre, Brussels), M. Csejthey-Barth, J. P. Lagnaux, and J. Sacton. Nuovo cimento (10), 20: 1017-21(June 1, 1961). (In English)

Proton interactions at 14 Bev with photographic emulsion nuclei were studied. Emulsion pellicles were exposed to an external beam of elastically scattered protons. The tracks were followed on the plates, and deflections greater than 2° in the plane of the emulsion sheet or 5° in the perpendicular plane were recorded. The interaction mean free path was found and a general analysis of the stars was made. Data are tabulated and/or graphically represented. (L.N.N.)

26940 PHOTOPROTONS PRODUCED BY 245 ± 15-Mev GAMMA RAYS ON CARBON. Robert J. Cence and Burton J. Moyer (Univ. of California, Berkeley). Phys. Rev. 122: 1634-9(June 1, 1961). (UCRL-9442)

A carbon target was bombarded by 342-Mev bremsstrahlung from the Berkeley synchrotron. The energy spectrum of protons produced at 60 deg was measured from 90 to 250 Mev. Interactions due to 245 ± 15 Mev gamma rays were selected out by requiring a coincidence between the protons from the target and the electrons associated with these gamma rays. Analysis was made using the quasi-deuteron model of Levinger. In contrast with previous analyses of this kind, conservation of both momentum and energy were taken into account in a fairly accurate way. Results of this analysis determine the momentum distribution of the centers of mass of the quasi-deuterons. The momentum distribution that results in the observed proton spectrum, normalized to one quasi-deuteron, is given by $(d^3N/dP_D^3) = [0.2/(4\pi ME_1)^{3/2}] \exp[-(P_D^2/4ME_1)] + [0.8/(4\pi ME_2)^{3/2}] \exp[-(P_D^2/4ME_2)]$, where $E_1 = 1.6$ Mev, $E_2 = 20$ Mev. (auth)

26941 CLUSTER MODEL CALCULATION ON THE ENERGY LEVELS OF THE LITHIUM ISOTOPES. Y. C. Tang (Florida State Univ., Tallahassee), K. Wildermuth, and L. D. Pearlstein. Phys. Rev., 123: 548-58(July 15, 1961).

A variational procedure is adopted to determine the energies of the levels of the highest space symmetry type in Li^6 and Li^7. The trial wave functions employed take into consideration the existence of cluster structures in those nuclei. With a simple two-body force, it is shown that the computed energies of the various states are in reasonable agreement with experiment. The $^2F_{\frac{5}{2}}$ level in Li^7, as yet undetermined experimentally, is found to have an excitation energy of about 5.6 Mev and a rather large level width. The calculation also indicates that to explain the splitting of levels in those nuclei, a constant two-body spin-orbit force of the pure neutral form is inadequate. (auth)

26942 MULTILEVEL ANALYSIS OF THE TOTAL NEUTRON CROSS SECTION OF Pu^{241} BELOW 12 ev. O. D. Simpson and M. S. Moore (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev., 123: 559-64(July 15, 1961).

Measurements of the total cross section of Pu^{241} have been analyzed with the use of a multilevel formula, under the assumption that the observed resonance asymmetries are due to interference in a small number of fission channels. As was the case for U^{233}, the analysis is interpreted as evidence that there are differences in the average fission widths of resonances belonging to the two possible spin states of the compound nucleus. (auth)

26943 DIRECTIONAL CORRELATION MEASUREMENTS IN Hf^{178}. U. Bertelsen, J. Borggreen, and O. Nathan (Univ. of Copenhagen). Phys. Rev., 123: 564-7(July 15, 1961).

Measurements of the directional correlations of the 1335–93 kev, 1345–93 kev, and 1390–93 kev γ-γ cascades in Hf^{178} have been made, using a liquid source of 21-day W^{178} in equilibrium with 9.3-min Ta^{178}. It is shown that the data support the tentative spin assignments of Gallagher et al. The 1390-kev γ ray is found to be almost pure quadrupole radiation. If the spin and parity of the 1430-kev level is 1+, as suggested by Gallagher et al., the multipolarity of the 1335-kev γ ray is determined by our measurements to be mainly M1. Using these results, the amount of E0 radiation in the 1309-kev transition has been estimated. It is found that approximately 70% of the 1390-kev K-conversion electrons are due to monopole transitions. (auth)

26944 DETERMINATION OF M1-E2 MIXING AMPLITUDES IN Mg^{25}, Al^{27}, Si^{29}, AND P^{31}. G. J. McCallum (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev., 123: 568-78 (July 15, 1961).

A method of analyzing gamma angular distribution and direction-polarization data to yield values for the relative amplitudes of mixed multipole gamma transitions is described. The analysis of the data does not demand a knowledge of the mechanism of formation of the gamma-emitting level. Measurements are reported on some mixed M1–E2 de-excitation gamma rays from low-lying levels in Mg^{25}, Al^{27}, Si^{29}, and P^{31}; these levels were excited by inelastic proton scattering. The results are tabulated. (auth)

26945 YIELD RATIOS FOR THE ISOMERIC PAIR $Sc^{44m\,44}$ FORMED IN (α,αn) AND (α,n) REACTIONS. Sylvia M. Bailey (Univ. of California, Berkeley). Phys. Rev., 123: 579-82(July 15, 1961).

The yield ratio of Sc^{44m}/Sc^{44} was measured in $Sc^{45}(\alpha,\alpha n)Sc^{44}$ reactions with helium ions of energies between 20 and 43 Mev and at 320 Mev. The measured ratio was nearly constant at a value of 1.5 between 20 and 43 Mev and was 0.62 at 320 Mev. The Sc^{44m}/Sc^{44} ratio was measured in $K^{41}(\alpha,n)Sc^{44}$ reactions at 10 and 43 Mev with values of 0.3 and 0.9, respectively. The isomer ratio was calculated for the K^{41}(10-Mev α,n)Sc^{44} reaction by means of a compound-nucleus model, and for the Sc^{45}(320-Mev α,αn)Sc^{44} reaction

by means of a classical knock-on model. The calculated ratios were 0.32 and 0.51, respectively. (auth)

26946 STATES OF Be^{11}, B^{11}, AND C^{11}. P. F. Donovan (Bell Telephone Labs., Murray Hill, N. J.), J. V. Kane, R. E. Pixley, and D. H. Wilkinson. Phys. Rev., 123: 589-97 (July 15, 1961).

The gamma-decay of the 4.46- and 5.03-Mev levels of B^{11} was determined by (p,γ) coincidences using the reaction $Be^9(He^3,p)B^{11}$. The 5.03-Mev level decays with a probability of 0.14 ± 0.03 via the state at 2.13 Mev; the intensity of the branch to the state at 4.46 Mev is less than 3×10^{-3}. The intensity of the branch from the 4.46-Mev level via that at 2.13 Mev is less than 5×10^{-3}. The data on these states are reviewed and the present results strongly favor the choices $J = \frac{1}{2}-, \frac{5}{2}-, \frac{3}{2}-$ for the states at 2.13, 4.46, and 5.03 Mev, respectively, without appeal to a model. It is, however, emphasized that the body of data as it stands at the moment might admit $J = \frac{1}{2}+$ for the 2.13-Mev state and $J = \frac{1}{2}-$ for the 5.03-Mev state. The previsions of the independent-particle model (IPM) are then examined and best general agreement between theory and experiment is achieved for $a/K \approx 4 - 4.5$. The likely relevance of the collective model is remarked upon. It is demonstrated with the aid of the reaction $B^{10}(p,\gamma)C^{11}$ that the ordering of the first three excited states of C^{11} is the same as in B^{11}. The beta-decay of Be^{11} is reconsidered in the light of the increased firmness of the assignments in B^{11} and of the previsions of the IPM; it is concluded that Be^{11} is most probably of even parity. (auth)

26947 ANGULAR DISTRIBUTION OF THE GROUND-STATE NEUTRONS FROM THE $C^{13}(p,n)N^{13}$ AND $N^{15}(p,n)O^{15}$ REACTIONS. C. Wong, J. D. Anderson, S. D. Bloom, J. W. McClure, and B. D. Walker (Univ. of California, Livermore). Phys. Rev., 123: 598-605(July 15, 1961). (UCRL-5946)

The angular distribution of the neutrons from the $C^{13}(p,n)N^{13}$ and $N^{15}(p,n)O^{15}$ ground-state reactions was measured in 10° steps from 0° to 150° for incident proton (laboratory) energies of approximately 6.5, 6.9, 7.5, 8.1, 8.6, 8.9, 9.4, 10.6, 11.4, and 12.2 Mev. Additional measurements were made for C^{13} at 5.0, 10.2, 10.9, and 13.3 Mev, and for N^{15} at 5.5, 7.7, 7.8, and 13.6 Mev. A calibrated plastic or stilbene scintillator was used in order to obtain absolute differential cross sections. Time-of-flight techniques on the Livermore variable energy cyclotron allowed positive identification of the ground-state neutrons. The targets [CO_2(58% C^{13}) and N_2(90% N^{15})] were sufficiently thick to average out the effects of possible compound-nucleus contributions. From preliminary fits to the C^{13} angular distributions, Glendenning and Bloom have inferred an effective neutron-proton interaction inside the nucleus. (auth)

26948 PROTON SPECTRA FROM THE NITROGEN BOMBARDMENT OF FLUORINE. C. E. Hunting (Oak Ridge National Lab., Tenn.). Phys. Rev., 123: 606-15 (July 15, 1961).

Energy spectra and absolute differential cross sections of protons from bombardment of F^{19} with 21.4- and 27.4-Mev N^{14} were measured. The energy spectra were analyzed in terms of the statistical model with a level density $\exp(E^*/T)$, where E^* is the excitation energy in the residual nucleus of the assumed reaction $F^{19}(N^{14},p)P^{32}$. The nuclear temperature T increased from about 1.9 Mev at 0° to about 2.5 Mev at 145°c.m., but did not vary with bombarding energy. The angular distributions show minima near 90°c.m., with anisotropy increasing as the bombarding energy and proton energy increase. At the lower bombarding energy there is approximate agreement with the Ericson-Strutinski theory of angular-momentum effects in compound-nucleus processes, over the entire observed ranges of angle and proton energy. The fit is consistent with $\sigma = 3$ in the nuclear level spin distribution $(2j + 1)\exp[-j(j + 1)/(2\sigma^2)]$. At the higher bombarding energy a considerable excess of protons are emitted into the backward hemisphere, especially at high proton energies, suggesting a direct-interaction mechanism in which the observed proton comes from the F^{19}. (auth)

26949 BETA-GAMMA DIRECTIONAL CORRELATION IN Eu^{154}. K. S. R. Sastry, R. F. Petry, and R. G. Wilkinson (Indiana Univ., Bloomington). Phys. Rev., 123: 615-18 (July 15, 1961).

The energy dependence of the beta-gamma angular correlation between the outer beta-ray group of Eu^{154}, W_0 = 1.86 Mev, and the 123-kev gamma ray of the daughter Gd^{154} has been measured with a shaped magnetic field beta-gamma coincidence spectrometer. A negative correlation coefficient, accurate to about 5%, is obtained which ranges from −0.10 to −0.17 in the energy region 0.80 to 1.60 Mev. It is shown that the modified B_{ij} approximation must be relaxed to explain the data. The nuclear parameters (Kotani's notation) which result are: $x = -0.24 \pm 0.05$, $u = -0.05 \pm 0.03$, $Y = +0.76 \pm 0.08$. These values are compared with those which have been reported for Eu^{152}: $x = u = 0$, $Y = 0.69 \pm 0.06$. (auth)

26950 STUDY OF THE DIFFERENTIAL CROSS SECTIONS OF DEUTERON STRIPPING REACTIONS AS A FUNCTION OF THE INCIDENT ENERGY. E. W. Hamburger (Univ. of Pittsburgh and Universidade, São Paulo, Brazil). Phys. Rev., 123: 619-26(July 15, 1961).

Angular distributions for the reactions $C^{12}(d,p)$ and $O^{16}(d,p)$ to the ground and first excited states of C^{13} and O^{17} were obtained at deuteron energies of 10.2, 12.4, and 14.8 Mev. These results and those of previous experiments at other energies between 3 and 19 Mev are compared with the predictions of the usual plane-wave Born approximation theory, due originally to Butler. The assumption of plane waves leads to the prediction that the differential cross section is a function of energy and scattering angle only through the transfer momentum q: angular distributions at different energies should coincide when plotted vs q. It is found that this is only approximately true on the main stripping peak of the angular distribution; at larger angles the cross section is a more complicated function of energy and angle. Furthermore the stripping peak itself shifts as a function of q, principally in the deuteron energy range 10 to 19 Mev. (auth)

26951 BETA-DECAY COUPLING CONSTANT AND THE ft VALUE OF O^{14}. R. J. Blin-Stoyle and J. Le Tourneux (Clarendon Lab., Oxford). Phys. Rev., 123: 627-8 (July 15, 1961).

A calculation is made of the effect of a charge-dependent internucleon potential on the $O^{14}(0^+, T = 1) \rightarrow N^{14}(0^+, T = 1)$ β-decay matrix element. It is found that a not unreasonable strength and form for such a potential can lead to a reduction in the matrix element ≈1% which is of the right order of magnitude to resolve the present discrepancy between the β- and μ-decay polar vector coupling constants. (auth)

26952 LIFETIMES OF ENERGY LEVELS IN Al^{28}, Mn^{56}, Cu^{64}, Rh^{104}, AND I^{128} EXCITED BY SLOW NEUTRON CAPTURE. S. J. du Toit and L. M. Bollinger (Argonne National Lab., Ill.). Phys. Rev., 123: 629-36(July 15, 1961).

Measurements of delayed coincidences between γ rays were used to determine the half lives of states excited by

slow-neutron capture in various nuclei. The half lives found were: Mn^{56}, first excited level 11.4^{+2}_{-3} nsec, second excited level 5.1 ± 0.5 nsec; Rh^{104}, first excited level 2.6 ± 0.2 nsec, 96-kev transition ≤0.6 nsec; Cu^{64}, first excited level ≤0.3 nsec, second excited level ≤0.3 nsec; Al^{28}, first excited level 2.3 ± 0.2 nsec; I^{128}, 30-kev level 8.8 ± 1.0 nsec, 137-kev level 8.0 ± 0.6 nsec, 90-kev transition ≤0.7 nsec. Measurements of pulse-height spectra satisfying the condition of prompt and delayed coincidence and measurements at neutron resonances of iodine were used to establish the presence of excited states at 30 and 137 kev in I^{128}. A previously unreported neutron resonance was observed in I^{127} at a neutron energy of 10.7 ev. (auth)

26953 ANGULAR ASYMMETRY THEOREMS FOR DECAY PRODUCTS. Murray Peshkin (Argonne National Lab., Ill.). Phys. Rev., 123: 637-41(July 15, 1961).

The method of Eberhard and Good, for using decay angular distributions to determine the spins of unstable systems, is developed. Their inequality, which expresses the impossibility of getting too symmetric a decay pattern from an asymmetric initial state, is tightened. The results are generalized to include spinning decay products. The Adair analysis is generalized in the same framework. (auth)

26954 INTERACTIONS OF 1.0-, AND 3.0-Bev PROTONS WITH Ag AND Br IN NUCLEAR EMULSION. Elizabeth W. Baker and Seymour Katcoff (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 641-6(July 15, 1961). (BNL-5306)

Stars produced in insensitive nuclear emulsions by 1.0–3.0 Bev protons have been classified into different groups depending on whether light fragments and/or fission fragments are emitted. Alpha particle spectra and angular distributions are presented for each of the various groups. The probability for light-fragment emission increases rapidly with increasing beam energy up to 2.0 Bev. The angular distribution of the light fragments is peaked forward but also shows a preference for emission at 90° to the beam. Fission events increase from ~3% of the interactions with Ag and Br at 1.0 Bev to ~11% at 3.0 Bev. Ranges and angular distributions are also given for the recoil and fission fragments. (auth)

26955 SPALLATION OF URANIUM AND THORIUM NUCLEI WITH Bev-ENERGY PROTONS. B. D. Pate and A. M. Poskanzer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 647-54(July 15, 1961). (BNL-5302)

Cross sections have been measured for the production of isotopes of uranium, protactinium, thorium, and actinium in the irradiation U^{238}, U^{235}, and Th^{232} with 0.68- and 1.8-Bev protons. In addition, some yields were determined at other bombarding energies ranging up to 6.2 Bev. Calculations of the cross sections at 1.8-Bev bombarding energy were made, based on recent Monte Carlo calculations of the knock-on phase of the interaction, combined with published systematics of nuclear evaporation, and several assumptions as to fission-evaporation competition. Even without fission competition the calculated yields are considerably lower than the experimental ones, indicating a failure of the model for the knock-on phase of the reaction to predict sufficient probability for simple processes with low deposition energy. In view of the better agreement with experiment that previous workers have obtained with this type of calculation for 0.34-Bev protons on uranium, it is suggested that the present discrepancy may be due to an overemphasis of meson processes in the proliferation of the knock-on cascade in the calculation. (auth)

26956 RECOIL-FREE RESONANT ABSORPTION IN Au^{197}. D. A. Shirley (Univ. of California, Berkeley), M. Kaplan, and P. Axel. Phys. Rev., 123: 816-30(Aug. 1, 1961). (UCRL-9554)

The Mössbauer absorption in Au has been measured at 4°K for the 77-kev gamma ray emitted by Au^{197} nuclei embedded in gold, platinum, stainless steel, iron, cobalt, and nickel. In each case, a Doppler-shift curve was measured to find the effective width and the chemical shift. The recoil-free fractions, f, are obtained with the aid of a straightforward analysis, which incidentally shows the errors that can be made in f if the chemical shift and effective width are not taken into account. The observed recoil-free emission fractions were found to be approximately 0.06 (Au), 0.34 and 0.14 (Pt), 0.24 (steel), 0.32 (Fe), 0.27 (Co), and 0.35 (Ni). The relative f values are correct; the correct absolute f values might require a multiplicative correction factor that could be as small as 0.53. Relatively large f values were obtained when the Au^{197} radioactive nuclei were in high Debye-temperature lattices composed of light nuclei. Particularly low f values were found when the largest radiation-damage effects were expected. The observed chemical shifts were (in units of 10^{-6} ev): <0.13 (Au), 0.26 (Pt), 1.3 (steel), 1.4 (Fe), 1.3 (Co), and 1.1 (Ni). These chemical shifts give information more directly interpretable than, but related to, the optical-isotope and isomer shifts and the Knight shift; the magnitudes of the shifts measure directly either the depletion or the enhancement of electron density at the radioactive nuclei in the different lattices. Zeeman splittings of the nuclear energy levels caused by local magnetic fields at Au had relative magnitudes of 1.0: 0.43: <0.10 for Fe, Co, and Ni lattices. If the magnetic moment of the 77-kev excited state in Au^{197} is 1.6 nm, the local magnetic fields in Fe and Co were 282 and 122 koe, respectively. (auth)

26957 "BREAKS" IN THE ACTIVATION CURVE OF THE $P^{31}(\gamma,n)P^{30}$ REACTION. D. Sadeh (Centre National de la Recherche Scientifique, Ivry, France). Phys. Rev., 123: 855-8(Aug. 1, 1961).

Discontinuities in the slope of the activation curve of the $P^{31}(\gamma,n)P^{30}$ reaction were found while using two large NaI(Tl) crystals to detect the annihilation gammas from P^{30}. These breaks correspond well with resonances found recently in the $Si^{30}(p,n)P^{30}$ reaction. The correspondence between breaks and known resonances in some light nuclei is discussed. Such a correspondence was found to exist in the case of N^{14}, F^{19}, and P^{31} and is in doubt in the case of C^{12}. The detection system used allowed accurate measurements of the thresholds of the $P^{31}(\gamma,n)P^{30}$ reaction (12.23 ± 0.04 Mev) and the $Cl^{35}(\gamma,n)Cl^{34}$ reaction (12.66 ± 0.04 Mev). (auth)

26958 INTERPRETATION OF EXPERIMENTAL (n,2n) EXCITATION FUNCTIONS. D. W. Barr, C. I. Browne, and J. S. Gilmore (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 123: 859-64(Aug. 1, 1961).

Radiochemically determined (n,2n) excitation functions for Sc^{45}, Tl^{46}, Ni^{58}, Cu^{65}, Ge^{70}, As^{75}, Sr^{84}, Rb^{85}, Rb^{87}, Y^{89}, Zr^{90}, Sn^{112}, Cd^{116}, Sb^{123}, and U^{238} have been interpreted in terms of the statistical model of nuclear reactions. Values of the level density parameter a are obtained and correlated with mass number. A procedure is outlined for predicting the magnitude of any (n,2n) cross section from the nuclear content of the target material. Two level density formulations are studied, and approximations customarily made in calculations of this sort are examined quantitatively. (auth)

26959 POLARIZATION CORRELATION MEASUREMENTS ON Eu^{154}. C. V. K. Baba (Atomic Energy Establishment, Trombay, India) and S. K. Bhattacherjee. Phys. Rev., 123: 865-70(Aug. 1, 1961).

The spins and parities of the 1400- and 1723-kev levels in

Gd^{154} are discussed on the basis of the polarization-directional correlation measurements on the 1277–123 and 725–998 kev gamma-gamma cascades following the β decay of Eu^{154}. In the case of the 1277–123-kev cascade, directional correlation measurements and the polarization correlation measurements of the 1277-kev gamma ray are made with liquid and solid sources. An attenuation in the anistropy of directional correlation and in the degree of linear polarization correlation was observed in both the sources, the attenuation in the solid source being greater. In the 725–998 kev cascade, the polarization of either of the two radiations was measured in two separate experiments. On the basis of these measurements, the spins and parities of both the 1400- and the 1723-kev levels in Gd^{154} are assigned 2^-. The performance of the apparatus was checked by measuring the polarization correlations of known cascades in Ni^{60}, Tl^{48}, Pd^{106}, and Sr^{88}. (auth)

26960 ANTISHIELDING OF NUCLEAR ELECTRIC HEXADECAPOLE MOMENTS. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 870-2 (Aug. 1, 1961). (BNL-5371)

The antishielding factor η_∞ for a possible nuclear electric hexadecapole moment was calculated for the Cu^+, Ag^+ and Hg^{2+} ions using the Hartree-Fock wave functions for the 3d, 4d, and 5d electrons involved. It was found that $\eta_\infty(Cu^+) \cong -1200$, $\eta_\infty(Ag^+) \cong -8050$, and $\eta_\infty(Hg^{2+}) \cong -63000$. The implication of these results is discussed. (auth)

26961 $Ca^{40}(p,\gamma)Sc^{41}$ REACTION. J. W. Butler (U. S. Naval Research Lab., Washington, D. C.). Phys. Rev., 123: 873-7(Aug. 1, 1961).

Proton capture by Ca^{40} was studied by means of observations of obht the prompt gamma rays from resonance states in the compound nucleus and the delayed positrons from the decay of the ground state. Targets of CaO were prepared by the electrodeposition of Ca onto a Pt backing followed by the oxidation of the Ca and the purging of impurities by heat. These targets were bombarded by protons from a 2-Mv Van de Graaff accelerator, producing the reaction $Ca^{40}(p,\gamma)Sc^{41}$. The gamma rays from this reaction were observed with the use of a 3-in. diam by 3-in. NaI(Tl) crystal and a 256-channel pulse-height analyzer. Positrons from the decay of Sc^{41} were detected with the use of a thin plastic phosphor, 1.5 in. diam by 0.012 in. thick. Two resonances in the reaction were observed at bombarding energies of 650 ± 5 kev and 1850 ± 10 kev. Two other possible resonances were observed at 1550 ± 15 kev and 1630 ± 15 kev. The 650-kev resonance corresponds to an excited state in Sc^{41} at 1.723 ± 0.011 Mev, has an integrated cross section of 0.02 ev barn (factor of 2 uncertainty either way), has a width of less than 5 kev, and involves a gamma ray whose energy was measured to be 1.71 ± 0.03 Mev. The 1850-kev resonance corresponds to an excited state in Sc^{41} at 2.883 ± 0.014 Mev, has an integrated cross section of 0.3 ev barn (factor of 2 uncertainty either way), has a width of less than 10 kev, and involves a gamma ray whose energy was measured to be 2.89 ± 0.02 Mev. (auth)

26962 ELASTIC SCATTERING OF IDENTICAL SPIN-ZERO NUCLEI. D. A. Bromley, J. A. Kuehner, and E. Almqvist (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev., 123: 878-93(Aug. 1, 1961).

Elastic scattering measurements have been carried out on the $C^{12} + C^{12}$ and $O^{16} + O^{16}$ systems in the energy range from 6 to 35 Mev using heavy-ion beams from the Chalk River tandem accelerator and Au-Si surface barrier detectors. At energies below the Coulomb barriers the Mott scattering predictions are in excellent accord with the measurements as functions of both angle and energy. At energies above the barrier the O + O excitation curve drops exponentially below the Mott predictions to a value of 10 mb/sr at $E_{c.m.} = 16.5$ Mev and remains approximately constant thereafter at that value; in contrast, the C + C excitation curve shows marked resonant interference structure. The states involved have $\tau \geq 10^{-21}$ sec, large compound elastic branching ratios Γ_e/Γ, and appear to correspond to resonant absorption of high-order partial waves, hence have high angular momentum. It is suggested that these states reflect a quasi-molecular interaction mechanism which is involved in grazing collisions of these nuclei and which is critically dependent upon the structure of the nuclei involved. (auth)

26963 PHOTOALPHA REACTION IN Sb^{121}. John H. Wolfe and John P. Hummel (Univ. of Illinois, Urbana). Phys. Rev., 123: 898-902(Aug. 1, 1961).

The $Sb^{121}(\gamma,\alpha)In^{117-117m}$ reaction has been studied by determining the radioactivities of the product nuclei in samples that were irradiated with bremsstrahlung of maximum energy varying from 15.5 to 24 Mev. Excitation functions for the total cross section and the cross sections to each isomer were obtained. The total cross section rises steadily over the energy range studied, reaching a value of 360 μb at 24 Mev. The ratio of the cross section for the direct production of the ground state to the cross section for the production of the isomer is constant over the energy range studied at a value of 2.60 ± 0.40. The total excitation function up to 18 Mev agrees well with cross sections calculated on the basis of a statistical theory for compound-nucleus decay. The cross-section predictions could not be made for higher energies. The observed ground-state-to-isomer cross-section ratio is consistent with that expected from a compound-nucleus mechanism and probably inconsistent with that expected from a direct mechanism. Thus, the reaction appears to involve compound-nucleus processes for the most part. (auth)

26964 3.14-hr ISOMERIC LEVEL IN Y^{90}. R. L. Heath, J. E. Cline, C. W. Reich, E. C. Yates, and E. H. Turk (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev., 123: 903-9(Aug. 1, 1961).

A previously unreported 3.14-hr isomeric activity was produced in Y^{90} by thermal neutron irradiation of Y^{89}. The thermal capture cross section for the production of the isomer was measured to be 1.0 ± 0.2 mb. The decay of the isomeric level is characterized by the emission of two cascade gamma rays of 0.482 and 0.203 Mev. Conversion coefficient measurements indicated that the isomeric level at 0.685-Mev decays by M4 or E5 radiation to an intermediate level at 0.203 Mev followed by a predominantly M1 transition to the ground state of Y^{90}. Gamma-gamma directional correlation measurements and internal conversion measurements indicated that the level at 0.203 Mev has spin 3 with odd parity and that the level at 0.685 Mev has spin 7 or 8 with even parity. A shell-model configuration of $(g_{9/2}d_{5/2})$ was assigned to the isomeric state. (auth)

26965 PROTONS FROM ALPHA-INDUCED REACTIONS. Wayne Swenson and Nikola Cindro (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 123: 910-22 (Aug. 1, 1961).

The results of proton energy spectra measured at several angles from 30.5-Mev alpha particle induced reactions on Al^{27}, V^{51}, Co^{59}, As^{75}, Nb^{93}, Rh^{103}, In^{115}, and Ta^{181} were analyzed using the statistical model. The analysis yielded the differential cross section $d^2\sigma/d\Omega dE$ and the relative level density $\omega(E)$ of the residual nucleus as a function of proton and excitation energy of the residual nucleus. The nuclear temperature $1/T \equiv d(\ln\omega)/dE$ and the level density param-

eter a of $\omega = C \exp[(aE)^{1/2}]$ were obtained. The energy and angular dependence of the spectra are adequately described by the statistical model at back angles, with the indication of the presence of a direct-reaction mechanism contribution at forward angles, which extends to high excitation energies. (auth)

26966 ELECTRON-SCATTERING STUDY OF NUCLEAR LEVELS IN COBALT, NICKEL, LEAD, AND BISMUTH. H. Crannell, R. Helm, H. Kendall, J. Oeser, and M. Yearian (Stanford Univ., Calif.). Phys. Rev., 123: 923-38(Aug. 1, 1961).

Inelastic scattering of 183-Mev electrons through angles of 40 to 90° in the laboratory was observed, leading to excitation of discrete nuclear excited states in Ni^{58}, Co^{59}, Ni^{60}, Pb^{208}, and Bi^{209}. The excitation energies were below 8 Mev. Born-approximation analysis of the measured inelastic form factors was used to deduce the multipolarities λ (when not previously known), and, by extrapolation, the transition rates for 15 corresponding gamma transitions. A number of groups of electric transitions for $\lambda = 2$, 3, and 4 were observed, each group having strikingly similar form factors. In all but one of these groups the ratios G of the observed gamma transition rates to the single-particle predictions were greater than 15, and for some transitions from 30 to over 100. One of the groups, in cobalt and the nickels, contains the 1.33-Mev E2 transition to the first excited state of Ni^{60}. Another group consists of fast E3 transitions, seen in all five nuclei, from states known as the "anomalous levels." They included the transition to the first excited state in Pb^{208} (G = 31) and a transition in Bi^{209} identical in energy and form factor. Among three slow E4 transitions in cobalt and the nickels was the 2.50-Mev $4^+ \rightarrow 0^+$ transition in Ni^{60}. The E4, E3, and an E2 transition in Co^{59} identify states analogous to the 4^+, 3^-, and 2^+ seen in the neighboring even-even nuclei. The last two transitions are strongly enhanced. A pair of fast 4.30-Mev E4 transitions was observed in Pb^{208} and Bi^{209}; their speed (G = 37) indicates they may constitute the lowest-energy configuration of 16-pole mode of excitation of the nuclear surface. Values of the collective vibrational parameters C_λ and B_λ and the degree to which some of the transitions exhaust ordinary sum rules support the conclusion that the inelastic scattering process is strongly exciting nuclear collective excitations. Some of the observed results are expected on the basis of the theory of collective vibrational excited states; some are the consequence of unidentified configurations. (auth)

26967 ENERGY LEVELS IN Na^{21}. R. E. Benenson and L. J. Lidofsky (Columbia Univ., New York). Phys. Rev., 123: 939-47(Aug. 1, 1961).

The Na^{21} nucleus was studied through two reactions: the $Ne^{20}(d,n)Na^{21}$ reaction using a fast neutron spectrometer, and the $Ne^{20}(p,\gamma)Na^{21}$ reaction using both single-crystal and Hoogenboom techniques. $\bar{E}_d$ for the neutron spectroscopy for the major part of the work was centered about 4.87 Mev, while the capturing resonance for the gamma-ray work was at $\bar{E}_p = 1.17$ Mev. Enriched neon was employed as target gas. Energy levels in Na^{21} are found at excitations of 0.33 ± 0.03 Mev, 1.77 ± 0.05 Mev, 2.42 ± 0.04 Mev, 2.80 ± 0.06 Mev, and 3.61 ± 0.06 Mev. From the neutron work level parameters can be assigned to the 0.33- and 2.42-Mev levels, while the from gamma-ray work spin limits and parity may be assigned to the 3.61-Mev level. This latter level corresponds to the 1.17-Mev capture resonance, and a study of the deexcitation cascades has been partially completed. A discussion of the level scheme of Na^{21} in terms of the collective model is given. (auth)

26968 NEUTRON CAPTURE CROSS SECTION OF GOLD AT 30 kev AND 64 kev. L. W. Weston and W. S. Lyon (Oak Ridge National Lab., Tenn.). Phys. Rev., 123: 948-9(Aug. 1, 1961).

The capture cross section of gold has been measured with kinematically collimated neutrons from the $Li^7(p,n)Be^7$ and $T(p,n)He^3$ reactions. The cross sections at 30.2 kev and 63.9 kev were found to be 0.767 ± 0.060 and 0.456 ± 0.040 barn, respectively. (auth)

26969 ISOMER RATIO FOR THE $Sn^{118}(\gamma,p)$ REACTION. John P. Hummel (Univ. of Illinois, Urbana). Phys. Rev., 123: 950-3(Aug. 1, 1961).

The relative yields of In^{117} and In^{117m} from the $Sn^{118}(\gamma,p)$ reaction were measured by gamma ray counting a sample of SnO_2 enriched in Sn^{118} that had been irradiated with 24-Mev bremsstrahlung. The measured ground to isomer yield ratio was 0.65 ± 0.15, and is consistent with predictions made on the basis of both the Wilkinson direct mechanism and the compound-nucleus mechanism. However, the values of the isomer ratios for the series of even-even tin isotopes (Sn^{118}, Sn^{120}, Sn^{122}, and Sn^{124}, the latter three from the work of Yuta and Morinaga) are not at all consistent with the predictions of the compound-nucleus mechanism but can be rationalized on the basis of the Wilkinson model, lending support for that theory for direct photoproton reactions. (auth)

26970 NUCLEAR ORIENTATION OF Pm^{143}. C. A. Lovejoy, J. O. Rasmussen, and D. A. Shirley (Univ. of California, Berkeley). Phys. Rev., 123: 954-6(Aug. 1, 1961). (UCRL-9452)

Promethium-143 was oriented in a crystal of neodymium ethylsulfate. The angular distribution of the 740-kev γ ray was found to be $W(\theta) = 1 - (0.065 \pm 0.006)P_2(\cos\theta)$ at 0.02°K. Values for the mixing ratio, δ, of the 740-kev γ ray of Nd^{143} were obtained as a function of the magnetic moment of the ground state of Pm^{143}. The spin of the excited state of Nd^{143} was assigned as 9/2−. An absolute lower limit of $|\mu| > 1.0$ was set on the magnetic moment of Pm^{143}. The mixing ratio of the γ ray of Nd^{143} was found to lie in the range $0.23 < \delta(E2/M1) < 0.35$. (auth)

26971 T = 3/2 LEVEL IN F^{19} AT 9.07 Mev. G. Amsel and G. R. Bishop (Ecole Normale Supérieure, Paris). Phys. Rev., 123: 957(Aug. 1, 1961).

Alpha particles emitted from the 9.07-Mev state of F^{19} formed by the reaction $O^{18}(p,\alpha)N^{15}$ were detected. The α-particle reduced width indicates that the isotopic spin of this state is T = 3/2 with an admixture of about 15% of T = 1/2. The spin of the state is determined to be 7/2 from the α-particle angular distribution, while odd parity seems to be favored. (auth)

26972 ISOTOPIC-SPIN RULE VIOLATION IN THE $B^{10}(d,\alpha)Be^8$ REACTION. J. R. Erskine and C. P. Browne (Univ. of Notre Dame, Ind.). Phys. Rev., 123: 958-67 (Aug. 1, 1961).

All previous tests of the isotopic-spin selection rule in (d,α) reactions were obscured by statistical weight factors because in each case the initial and final nuclear states had spin and parity 0^+. The $B^{10}(d,\alpha)Be^8$ reaction provides a test of the isotopic-spin selection rule free from this restriction. The energy levels of Be^8 near the lowest T = 1 level were studied with the $Li^6(He^3,p)Be^8$ and $Be^9(He^3,\alpha)Be^8$ reactions as well as with the $B^{10}(d,\alpha)Be^8$ reaction. Energy levels in Be^8 were found at 16.623 ± 0.010 Mev, 16.921 ± 0.010 Mev, and 17.637 ± 0.006 Mev. The widths are 95 ± 20 kev, 85 ± 20 kev, and <15 kev, respectively. The first of these levels is the lowest T = 1 state, whereas the sec-

ond is T = 0 and the third probably T = 1. Energy levels at 16.08 Mev and a J = 2 level at 17.7 Mev, reported by other laboratories, were not observed. The ratio of the differential cross sections for formation of the 16.62- and 16.92-Mev levels was measured over a range of angles and bombarding energies. The ratio is about 1.4 and is roughly constant for both the $Li^6(He^3,p)Be^8$ and $B^{10}(d,\alpha)Be^8$ reactions. This implies complete violation of the selection rule because the latter reaction should not go to the T = 1 level. Arguments are given which indicate that the T = 0 impurities in the 16.62-Mev T = 1 level are probably quite small. Consequently, the failure of the selection rule probably results from the complete intermixing of T = 0 and T = 1 states in the C^{12} compound nucleus near 28-Mev excitation. Groups from the $C^{12}(He^3,p)N^{14}$ reaction were seen corresponding to levels in N^{14} at 5.691 ± 0.008, 5.834 ± 0.008, 6.203 ± 0.008, and 6.440 ± 0.008 Mev. (auth)

26973 THEORY OF AVERAGE NEUTRON REACTION CROSS SECTIONS IN THE RESONANCE REGION. P. A. Moldauer (Argonne National Lab., Ill.). Phys. Rev., 123: 968-78(Aug. 1, 1961).

The scattering matrix for compound nucleus processes is studied in the R-matrix formalism, using a series expansion which is due to Thomas. It is shown that this series generally converges when (a) the average total resonance width is less than the average resonance spacing, (b) the number of important channels is not too large, and (c) the width amplitudes have random signs. The treatment also suggests strongly that the series does not converge in the continuum region. In the region of convergence the exact relationship between the channel transmission factor T_c and the ratio of partial width to level spacing is found, in the absence of direct scattering reactions, to be $T_c = 2\pi(\Gamma_{\lambda c})/D - \pi^2(\Gamma_{\lambda c})^2/D^2$. The quadratic term is shown to be important in the vicinity of optical-model maxima. Correction terms to the Hauser-Feshbach relations for average reaction cross sections arising from the higher order terms of the series are obtained and are found to depend on the statistical properties of both resonance widths and resonance spacings. The effect on average neutron inelastic, compound elastic, and capture cross sections is discussed and an example of a calculation is presented. (auth)

26974 DECAY OF Tm^{172}. R. G. Helmer and S. B. Burson (Argonne National Lab., Ill.). Phys. Rev., 123: 978-91(Aug. 1, 1961).

The radioactive nuclide Tm^{172} was produced by successive capture of two neutrons in erbium oxide enriched in Er^{170}. The irradiations were made in the Materials Testing Reactor at Arco, Idaho. In addition to three thulium activities, these samples contained six active contaminants. Pure thulium sources were obtained by use of an ion-exchange column. Studies were conducted with a 256-channel coincidence scintillation spectrometer. These measurements indicate the presence of at least 17 gamma-ray and 5 beta-ray transitions. The beta-ray spectrum was studied with a 180° magnetic beta-ray spectrometer. This spectrum was analyzed by use of a computer program compiled by the authors in collaboration with members of the Argonne Applied Mathematics Division. The level scheme proposed for Yb^{172} has states with energies, spins, and parities of 0.0(0^+), 0.079(2^+), 0.260(4^+), 1.17(3), 1.46(2), 1.54(3), 1.60(1), 1.64(?), and 1.73(3) Mev. The total decay energy is found to be 1.88 Mev. The experimental data are consistent with the previously proposed interpretation that the first two excited states are members of a K = 0 rotational band based on the ground state. The states at 1.46 and 1.54 Mev are interpreted as members of a rotational band with K = 2. The states at 1.60 and 1.73 Mev are tentatively interpreted as members of a rotational band with K = 0 and negative parity. It is suggested that the state at 1.17 Mev has K = 3. From the analysis of the beta spectrum it is concluded that the ground state of thulium has I = K = 2 and negative parity. (auth)

26975 ENERGY LEVELS IN $_{69}Tm^{172}$ FROM THE DECAY OF $_{68}Er^{172}$. R. G. Helmer and S. B. Burson (Argonne National Lab., Ill.). Phys. Rev., 123: 992-6 (Aug. 1, 1961).

The radioactive nuclide Er^{172} was produced in the Materials Testing Reactor, Arco, Idaho by the successive capture of two neutrons in erbium oxide enriched in Er^{170}. In addition to three erbium activities and the radioactive Tm^{172} daughter, these samples contained six active contaminants from which the erbium was separated by use of an ion-exchange column. Scintillation studies, conducted with a 256-channel coincidence scintillation spectrometer, indicate the presence of at least eight gamma-ray transitions. Two of these transitions are either highly K converted or their transition energies are approximately 50 kev. The energies of the other six transitions are about 610, 450, 408, 200, 160, and 125 kev. Beta-gamma coincidence experiments indicate the presence of two beta-ray components at approximately 310 kev (in coincidence with the 610-kev gamma ray) and 370 kev (in coincidence with the 408-kev gamma ray). The level scheme deduced for Tm^{172} has excited states at 408, 450 (or 160), 470 ± 15, 530, and 610 kev. From the beta-ray intensities, the states at 530 and 610 kev are assigned spins of either 0 or 1 with positive parity. The spin and parity (2^-) of the thulium ground state have previously been assigned from the properties of the decay of Tm^{172}. (auth)

26976 AUTO-IONIZATION OF THE (1s2s2p) $^4P_{5/2}$ LEVEL IN Li AND He^-. Jerry L. Pietenpol (Columbia Univ., New York). Phys. Rev. Letters, 7: 64(July 15, 1961).

The lifetimes for autoionization of the (1s2s2p) $^4P_{5/2}$ levels in Li and He^- are calculated. The autoionization process must proceed to a $^2F_{5/2}$ two-electron final state, because of energy, parity, and angular momentum considerations. The resulting lifetimes are 16 μsec for Li and 1.7 msec for He^-. The continuum electron emitted is approximated as a plane wave. (T.F.H.)

26977 STRUCTURE IN THE KINETIC ENERGY SPECTRUM OF FRAGMENTS FROM THERMAL-NEUTRON-INDUCED FISSION OF U^{235}. W. M. Gibson (Bell Telephone Labs., Murray Hill, N. J.), T. D. Thomas, and G. L. Miller. Phys. Rev. Letters, 7: 65-6(July 15, 1961).

The fine structure in the thermal neutron fission of U^{235} is observed. The kinetic-energy spectra of the heavy and light fission products are found by coincidence counting, and the results of these measurements are used to calculate the fine structure of the fission yield spectra and total kinetic energy spectra. (T.F.H.)

26978 PROMPT FISSION YIELDS AND TOTAL KINETIC ENERGY BEHAVIOR FROM TIME-OF-FLIGHT MEASUREMENTS. J. C. D. Milton (Univ. of California, Berkeley), and J. S. Fraser. Phys. Rev. Letters, 7: 67-9(July 15, 1961).

The thermal-neutron fission of U^{233}, U^{235}, Pu^{239}, and Cf^{252} is studied. The total kinetic energy of the fission products is measured and calculated as a function of the heavy fission product mass number. A large drop is observed in the total kinetic energy near symmetric fission. The fine structure of the mass yields is shown by means of mass-energy contour diagrams. (T.F.H.)

26979 THOMAS-FERMI MODEL WITH SPIN ORBIT COUPLING ENERGY AND MOMENTUM-DEPENDENT POTENTIAL-ENERGY AND ITS APPLICATION TO THE ATOMIC NUCLEUS. Han-chao Liu (Nankai Univ.,). Wu Li Hsüeh Pao, 16: 348-64(June 1960).

The Thomas–Fermi model is generalized, for an approximately spherically symmetric system, to include the spin orbit coupling and the momentum-dependent potential energies. The model may be considered in the nuclear case as an approximate generalization of Bruechner's theory of a finite nucleus. (L.N.N.)

Particle Accelerators

26980 (UCRL-9743) DEVELOPMENT OF A 100-ma PROTON SOURCE AND LENS SYSTEM FOR THE BEVATRON MARK-II INJECTOR. Robert W. Allison, Jr., Bruce Cork, Robert M. Richter, Joseph F. Smith, Glenn E. White, and Emery Zajec (California. Univ., Berkeley. Lawrence Radiation Lab.). June 12, 1961. Contract W-7405-eng-48. 44p.

A Von Ardenne type ion source and lens system was developed for use as a preinjector to the 18-Mev strong-focusing linear accelerator. Proton beams of 120 ma at an ion production efficiency of 83% were obtained. A magnetic beam-confining system was built and a beam of 85 ma was transported 82 inches. The beam energy was 370 kev, and its emittance was 100 mrad-mm. The beam diameter was 1 cm. This is within the linear accelerator's calculated acceptance of 179 mrad-mm. (auth)

26981 A DIGITAL DATA HANDLER FOR PULSED PARTICLE ACCELERATORS. W. A. Higinbotham and D. W. Potter (Brookhaven National Lab., Upton, N. Y.). IRE Trans. Nuclear Sci., NS-8: No. 3, 51-6(July 1961).

A digital data handler for storing information in a magnetic core memory during the pulse of a synchrotron and transferring it to a slow memory during the dead time is described. Digital measurements of trajectory, pulse height, time of flight, run number, etc., are typical data. The magnetic core memory provides capacity for storing 32 words (events) of 96 bits during a burst. The information contained in the core memory is then transferred to one inch magnetic tape during the dead time of the accelerator. Thence the information may be fed to a computer for future study. For economy, the data handler has one buffer which serves as the input, output and shift register. (auth)

26982 PULSE-SHORTENING IN ELECTRON LINEAR ACCELERATORS. M. C. Crowley-Milling, T. R. Jarvis, C. W. Miller, and G. Saxon (Associated Electrical Industries, Ltd., Manchester, Eng.). Nature, 191: 483-4(July 29, 1961).

A theory on pulse shortening in electron linear accelerators was evolved and verified experimentally. As a result, various methods of avoiding the problem were devised. (C.H.)

26983 PROPOSAL FOR A STORAGE RING FOR RELATIVISTIC CHARGED PARTICLES. R. Evangelisti and G. Sacerdoti (CNEN, Frascati, Italy). Nuclear Instr. & Methods, 12: 201-2(June 1961). (In English)

The design principles of a storage ring for storing charged particles, such as electrons or positrons, are presented. A diagram is presented of the storage ring showing the two magnet sections and the three RF cavities C_1, C_2, and C_3. The latter are tuned to a multiple of the particle revolution frequency, which depends only on the magnetic field due to the magnets. (N.W.R.)

26984 THE CERN 600 Mev SYNCHROCYCLOTRON AT GENEVA. I. OBJECT AND DESIGN. W. Gentner (Max-Planck-Institut für Kernphysik, Heidelberg, Ger.). Philips Tech. Rev., 22: 141-9(1960/61). (In English)

Principal considerations governing the choice of energy and the design are discussed, particularly the building layout and its minimization of the radiation background in the experiment rooms. The synchrocyclotron, its salient features of construction, and the targets and particle beams produced are mentioned. The internal proton beam current is 0.3 μA and 6% is extracted. Intensive beams of π and μ mesons are available. (L.N.N.)

26985 THE CERN 600 Mev SYNCHROCYCLOTRON AT GENEVA. II. THE RADIOFREQUENCY SYSTEM. K. H. Schmitter (Max-Planck-Institut für Physik und Astrophysik, Munich) and S. Kortleven. Philips Tech. Rev., 22: 149-61(1960/61). (In English)

The RF system of the CERN synchrocyclotron, the main components of which are the resonator (dee system) and the RF generator, was developed and built by Philips Eindhoven in cooperation with CERN engineers. On the basis of theoretical considerations and experiments with three different models, a resonator was finally built whose resonant frequency is swept through the required range from 29 to 16.5 Mc by means of a capacitance variation from 256 to 2580 pF of the modulation capacitor (tuning fork). The construction of the resonator, and the measures taken to avoid mechanical strains, are broadly described. The oscillator operates as a "flywheel" circuit, the control voltage for the oscillator valve (water-cooled 100 kw triode TBW 12/100) being taken from a feedback circuit in the oscillator, although the resonator — which is connected at one point — still governs the frequency, owing to its high Q. With this circuit, little trouble is experienced from unwanted modes of oscillation in the RF system. (auth)

26986 THE CERN 600 Mev SYNCHROCYCLOTRON AT GENEVA. III. THE TUNING-FORK MODULATOR. B. Bollée (Philips Research Labs., Eindhoven, Netherlands) and F. Krienen. Philips Tech. Rev., 22: 162-80 (1960/61). (In English)

The frequency modulation of the CERN synchrocyclotron is effected by a capacitor made to vibrate at 55 c, which was developed by the Philips Eindhoven laboratories in cooperation with the CERN. The capacitor comprises an aluminum "tuning fork" about 60 cm long and 2 meters wide. The longitudinal profile of each blade is a truncated wedge. Spring suspension and an electromagnetic drive system with an auxiliary mass ensures that no vibrations are transmitted to surrounding parts. Stiffening ribs fitted to the blades prevent the excitation of unwanted modes of vibration. The heat generated in the blades by the RF currents is removed by water-cooling at the foot. Experiments showed that the resultant warp of the lips is less than 0.2 mm. A control system using five feeler devices automatically maintains the position and amplitude of the blades during vibration to within 0.1 mm. The tuning-fork modulator has now operated satisfactorily for about three years. (auth)

26987 THE ULTRA-HIGH-VACUUM SYSTEM FOR THE C-STELLARATOR. Karl Dreyer and John T. Mark (RCA, Electron Tube Div., Lancaster, Penna.). RCA Rev., 21: 508-46(Dec. 1960).

Welding and joining of stainless steels, assembling glass and ceramics into vacuum vessel systems, and achievement of an ultra-high vacuum and its accurate measurement are described. Many of the arts of electrical control systems, material cleaning, lubrication and movement of parts in

vacuum, and electrical and thermal insulation, are also discussed. (auth)

26988 HIGH VOLTAGE PULSE TRANSFORMER AND A DEVICE FOR PRODUCING A PULSED BEAM OF ENERGETIC ELECTRONS. (to U. S. Atomic Energy Commission). British Patent 875,574. Aug. 23, 1961.

An improved high-voltage pulse transformer is designed for use in an electron gun for the production of high-current, high-energy electron beam pulses of extremely fast rise times. The transformer contains a plurality of circumferentially spaced magnetic cores coupled with a plurality of primary windings in vacuum. Since no insulation is used, the shunt capacity of the secondary winding is minimized, leading to fast pulse times. (D.L.C.)

Plasma Physics and Thermonuclear Processes

26989 (AD-253995) DIFFUSION THEORY OF THE ELECTRODELESS RING DISCHARGE. Research Report No. 9. Hans U. Eckert (Convair, San Diego, Calif.). Feb. 13, 1961. 38p.

An approximate simultaneous solution of the wave equation and the electron-balance equation is obtained for the case of an inductive, diffusion-controlled glow-discharge in a long cylindrical tube at radiofrequencies. The analysis rests on the two critical assumptions that: the function representing electron production across the tube is sufficiently close determined by its value and tangent at the tube wall; and the field distribution can be obtained from an effective uniform conductivity $\bar{\sigma}$ which yields the same impedance as the actual conductivity distribution. On this basis the value of $\bar{\sigma}$ as well as the distribution of electron density, n, related to its value at the tube axis, n_0, are determined. With the additional assumption of constant electron collision frequency a relationship between $\bar{\sigma}$ and n_0 is derived which allows the calculation of absolute distributions of n and σ. The distributions are nearly consistent with the field distribution in two cases. The first case is that of negligible interference and requires that the conductivity level is low enough to make the skin depth larger than the tube radius. The second case is that of a nearly rectangular σ-distribution. It is approached when the conductivity level is so high that the ratio of skin depth to tube radius becomes vanishingly small and the product tube radius times gas pressure is large. The method is illustrated by practical examples for hydrogen, which indicate that the maximum obtainable electron concentration depends strongly on the product between frequency and intensity of the applied magnetic field but only moderately upon the gas pressure and not on the tube radius. (auth)

26990 (AFCRL-TN-60-809) REFRACTIVE INDEX FOR PLANE WAVE PROPAGATION IN A LOSSLESS MAGNETO-IONIC MEDIUM. Scientific Report No. 2. G. A. Deschamps (Illinois. Univ. Urbana. Electrical Engineering Research Lab.). July 15, 1960. Contract AF19(604)-5565. 22p. (AD-250484)

A discussion is given of the evaluation of the dielectric constant and refractive index corresponding to plane waves propagating in a magneto-ionic media for the case where the losses are negligible but the angle Θ between the direction of propagation and the magnetic field is arbitrary. (B.O.G.)

26991 (AFOSR-165) NON-EQUILIBRIUM EFFECTS ON CONDUCTIVITY AND ELECTRODE HEAT TRANSFER IN IONIZED GASES. Technical Note No. 4. Jack L. Kerrebrock (California Inst. of Tech., Pasadena. Guggenheim Jet Propulsion Center). Nov. 1960. Contract AF 49(638)-758. 45p.

A simple theory of non-equilibrium conduction in ionized gases was developed, which accounts for the elevation of the electron temperature by energy gain in the electric field. It is assumed that the ionization is in equilibrium at the electron temperature. The theory yields a modified Ohm's law, such that the current density varies as a power of the electric field. The power is unity for gases at high temperatures, but can be very large at low gas temperatures. Measurements carried out with hot tantalum electrodes in an argon-potassium plasma at 1500 to 2500°K, at atmospheric pressure, agree with the predicted variations of the conductivity with both current density and gas temperature. This is regarded as a verification of the assumption of ionization equilibrium at the electron temperature. Both the theory and experiments indicate that the augmentation of electrode heat transfer by Joule heating in the boundary layer is less important than equilibrium theory predicts it to be. (auth)

26992 (AFOSR-682) AN EXPERIMENTAL INVESTIGATION OF THE BEHAVIOR OF AN ARC POSITIVE COLUMN IN THE PRESENCE OF FORCED CONVECTION. Paul G. Thiene, James E. Chambers, and Woldemar v.' Jaskowsky (Plasmadyne Corp., Santa Ana, Calif.). Apr. 29, 1961. Contract AF 49(638)-334. 94p. (T-4TN031-334)

An experimental investigation was made concerning the behavior of low-current arc positive columns in the presence of subsonic, laminar forced convection. Columns in argon at atmospheric pressure were drawn between collinear electrodes and deflected by convection normal to the interelectrodes axis. Photographs of deflected columns over a current range 2 to 6 amperes for various incident convection velocities up to approximately 200 cm/sec were taken and analyzed. The results are compared with theoretical predictions. A cursory investigation was also conducted into the effects of magnetic fields applied transverse to columns as to oppose the forced convection. (auth)

26993 (AFOSR-994) PLASMA BOUNDARY LAYERS. Magnetogasdynamics Laboratory Report No. 61-8. James A. Fay (Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering). June 1961. Contract AF49 (638)-643. 18p.

Some aspects of boundary-layer-type flows in gases that are partially or wholly ionized are considered. The changes in transport properties due to ionization are estimated, and the resulting effects on heat transfer in a monatomic gas are determined. A type of magnetohydrodynamic boundary layer encountered in channel flows in which there exists an applied magnetic field normal to the wall is considered. The laminar diffusive mixing of a magnetic field and a compressible plasma is also studied. (auth)

26994 (AFOSR-998) IONIZATION PROCESSES IN GASES. Final Report. Hendricus G. Loos (Plasmadyne Corp., Santa Ana, Calif.). Mar. 31, 1961. Contract AF49 (638)-655. 15p. (FR-031-655)

A theoretical investigation of the ionization occurring during the initial phase of an axisymmetric electrodeless discharge is reported, using H_2 as an example. It is found that, for a given voltage induced around the gas column and for a given gas column diameter, there is a best density for ionization. A toroidal discharge tube for checking the theory is described. (D.L.C.)

26995 (AFSWC-TR-61-1(II)) RADIATIONS FROM AN EXPANDING PLASMA IN AN EXTERNAL MAGNETIC FIELD. [VOLUME] II. H. Rosner (Republic Aviation

Corp. Missile Systems Div., Mineola, N. Y.). Jan. 20, 1961. Contract AF 29(601)-2324. 104p.

Radiation from expanding plasma in magnetic fields is investigated. The types examined include dipole radiation due to surface currents, the surface cyclotron and synchrotron radiations, and volume synchrotron radiation. In each case, the total radiation loss rates are derived along with other radiation characteristics such as directional intensities and spectral structure. In the calculation of surface and volume radiation, the nonrelativistic phenomena are based on a Maxwellian electron distribution, while in the relativistic case a high-energy beta-decay spectrum is assumed. (auth)

26996 (APL-JHU-CF-2915) THEORETICAL ANALYSIS OF PLASMA CONFINEMENT IN A ROTATING MAGNETIC FIELD. D. K. Taylor (Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.). Jan. 25, 1961. 33p.

Equations of motion are solved for charged particles in rotating magnetic fields. Particle orbits are derived for special limiting cases and compared with analog computer solutions. It is found that a rotating magnetic field confines a plasma in the plane of rotation but not always in the normal direction and that a rotating field used in conjunction with other types of stationary fields should result in an effective plasma containment device. (D.L.C.)

26997 (CLM-L-1) HYDROMAGNETIC STABILITY THEORY, A Brief Survey. R. J. Tayler (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Oxfordshire, England). June 1961. 11p.

A review of hydromagnetic stability theory is presented. The idealized hydromagnetic equations for a system are shown, and the effects of several approximations to these equations are described. The stability of a system that obeys the idealized hydromagnetic equations is discussed. Hydromagnetic instabilities are assumed to be describable in terms of closed hydrodynamical equations, so that the detailed particle distributions, and hence the high frequency behavior of the system, are ignored. An example is studied, however, in which the low frequency behavior of the system affects the hydromagnetic stability. (T.F.H.)

26998 (LAMS-2571) PRESSURE BALANCE IN THE TOROIDAL ORTHOGONAL PINCH. B. R. Suydam (Los Alamos Scientific Lab., N. Mex.). May 1961. Contract W-7405-ENG-36. 15p.

It is noted that a pure toroidal magnetic field cannot produce a toroidal orthogonal pinch, but that a poloidal field component is necessary. Calculations are carried out to find minimum toroidal current necessary to produce a poloidal field capable of sustaining the pinch. Two models are studied: a pinch having a sharp boundary and no internal magnetic field, and a diffuse pinch. (T.F.H.)

26999 (ML-820) PLASMA SHEATH FORMATION BY RF FIELDS. Harold Sims Butler (Stanford Univ., Calif. Microwave Lab.). Apr. 1961. Contract AF49(638)-415. 98p. (AFOSR-673)

Experimental observations show that the application of a r-f voltage of 10 kcs to 30 Mcs to any one of several electrode configurations around the outside of a plasma discharge tube results in a constriction of the light-emitting portion of the plasma away from the inner walls of the glass tube. The phenomenon was initially thought to be the result of the r-f confinement mechanism proposed earlier. The present investigation established that the phenomenon is not r-f confinement but rather the result of an interaction between the externally applied voltage and the plasma which leads to the formation of a d-c positive ion sheath. Four experimental measurements together with a description of the equipment utilized in obtaining them are presented which define the general characteristics of the interaction. It is shown how the results of experiments using square waves instead of sine waves for the input signal suggested that the whole system—plasma, glass wall, and generator—could be reduced to a simple circuit. The key step in this reduction was the representing of the plasma as the resultant of two voltage-dependent current sources, one relating to the d-c probe characteristic of the plasma, the other to the physical movement of a body of electrons toward and away from the wall. This recognition of the plasma as a current source together with the knowledge that there must be no average net current flowing to an insulator (the wall) provided the basis of a physical mechanism which explains how the interaction occurred and why it led to the visual observations. The physical mechanism was described mathematically in terms of a differential equation. An approximation to the differential equation was derived whose solution was shown to fit qualitatively all the general characteristics of the phenomenon with regard to its dependence on arc current and on the frequency and amplitude of the applied voltage. The differential equation was solved in its most general form and the solution was shown to fit the experimental observations quantitatively for both square and sine wave inputs. An application of this phenomenon as a possible external diagnostic probe technique is proposed. (auth)

27000 (NP-10380) THEORETICAL INVESTIGATION OF ELECTRON ORBITS AND BREMSSTRAHLUNG IN A PLASMA. Otto H. Theimer (New Mexico State Univ., University Park). Jan. 1961. Contract N9onr-953(07). 38p.

A method for calculating the partition function of real gases is developed and applied to the case of a plasma. The electrostatic energy, $\bar{U}$, is represented as a function of the Fourier coefficients, A_ρ, of the particle density and, with the A_ρ as independent variables, the configuration integral, Z, is evaluated by direct integration. A zeroth order approximation, Z^0, is obtained which approaches the correct value Z just in the cases of low temperature and high ion density which cannot easily be handled by standard methods. In these cases, $|\bar{U}|$ is found smaller, by 29%, than the familiar Debye-Hückel energy. (auth)

27001 (NP-10462) RELAXATION TIME FOR THE TWO-PARTICLE CORRELATION FUNCTIONS IN A PLASMA. Ralph L. Guernsey (Boeing Scientific Research Labs., Seattle). Dec. 1960. 36p. (D1-82-0083)

The behavior in time of the two-particle correlation function of a plasma is studied. The one-particle distribution is represented as the Maxwell distribution plus a perturbation, and the correlation function as the equilibrium correlation function plus a perturbation. For states near equilibrium, the equation for the correlation function may be linearized in the perturbations. This linear equation is used to find a time-dependent correlation function in terms of the perturbation of the one-particle distribution. Both spatially homogeneous and inhomogeneous cases are considered. The results are studied in terms of a relaxation time. (T.F.H.)

27002 (NP-10565) SUMMARY OF SHERWOOD ACTIVITIES. (Defense Atomic Support Agency. Field Command, Albuquerque, N. Mex.). July 15, 1961. 54p.

A qualitative description is presented of thermonuclear reactions, plasma heating and cooling mechanisms, and the physical characteristics of a plasma. The status of thermonuclear research projects sponsored by AEC as of June 1961 is described. Experimental devices such as the DCX, Astron, etc., are described in some detail. (D.L.C.)

27003 (ORNL-3162) STABILITY OF PLASMAS AGAINST ELECTROSTATIC PERTURBATIONS. T. K. Fowler (Oak Ridge National Lab., Tenn.). Aug. 10, 1961. Contract W-7405-eng-26. 28p.

The notation $(\partial f/\partial t) + Vf = 0$ is used for the linearized self-consistent field (Vlasov) equation governing "collisionless" plasmas. It is shown that if only the Coulomb force between particles is taken into account, a sufficient (and generally necessary) condition for stability of an equilibrium distribution $f_0(\vec{x},\vec{v})$ against small perturbations f is that the linear operator V, a function of f_0, be anti-Hermitian in some representation. Using this symmetry requirement, a class of stable functions is found that includes spatially-confined distributions that could represent a plasma held together by gravitational forces. Qualitative limits on the nature of unstable perturbations in thermonuclear "mirror" machines are determined. The stability criterion is shown to apply to other classical systems with central two-body forces. (auth)

27004 (RISO-18) INTERNATIONAL SUMMER COURSE IN PLASMA PHYSICS, 1960. (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). Nov. 1960. 652p.

A compilation which contains the essentials of the lectures is presented. Thirty-seven papers are included of which 16 have been previously abstracted for NSA. For 21 papers separate abstracts were prepared. (J.R.D.)

27005 (RISO-18(p.1-11)) INTRODUCTION TO PLASMA PHYSICS. Marshall N. Rosenbluth (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

A review and general outline of plasma physics is presented. (J.R.D.)

27006 (RISO-18(p.13-23)) INTRODUCTION TO SINGLE PARTICLE PICTURE. P. Hubert (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses).

A review of the general laws of charged particle motion is presented, and simplification techniques for use in typical situations which occur in plasma studies are discussed. (J.R.D.)

27007 (RISO-18(p.25-33)) THE MOTION OF A PARTICLE IN A MAGNETIC FIELD. ADIABATIC INVARIANCE. H. C. Brinkman (Netherlands. TNO. Centraal Laboratorium, Delft).

A discussion of the motion of charged particles in specified electromagnetic fields is presented. The discussion is limited to constant inhomogeneous magnetic fields. The motion equation is integrated and an analysis of adiabatic invariants is included along with a numerical example. (J.R.D.)

27008 (RISO-18(p.35-44)) THE CONSTANCY OF THE ORBITAL MAGNETIC MOMENT IN A TIME VARYING MAGNETIC FIELD. A. Schlüter (Max-Planck-Institut für Physik and Astrophysik. Munich).

An analysis is presented of the non-relativistic motion of charged particles in time-varying homogeneous magnetic fields which are subject to electric fields derived from variations of such magnetic fields. Results of the approximate theory application are discussed. (J.R.D.)

27009 (RISO-18(p.45-53)) INTRODUCTION TO MAGNETO HYDRODYNAMICS. H. C. Brinkman (Netherlands. TNO. Centraal Laboratorium, Delft).

The introduction contains a description of fully ionized plasma as an electron- and an ion-gas. Equations of fluid dynamics for these gases are presented and discussed. The derivation of these equations from particle dynamics theory is presented elsewhere. (J.R.D.)

27010 (RISO-18(p.61-100)) COLLISIONLESS BOLTZMANN EQUATION. Albert Simon (Oak Ridge National Lab., Tenn.).

An analysis of equations for plasmas leads to the conclusion that a proper first approximation to the exact equations of plasmas is to neglect the collision integrals entirely in the Boltzmann equation. The resulting equation, together with the Maxwell equations for the electric and magnetic fields, constitutes a set of equations known either as the Collisionless Boltzmann Equation or more frequently the Vlasov Equations. The approximations in the Vlasov equation are entirely different from those of magnetic-hydrodynamics, even though in some regimes the two theories seem to yield similar equations. Further discussion of the Vlasov Equations and entropy conservation is included along with analyses of Landau damping, and transverse oscillations. (J.R.D.)

27011 (RISO-18(p.101-18)) FLUCTUATIONS: THE FOKKER PLANCK EQUATION FOR A PLASMA. W. B. Thompson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Approaches are described to the problem of determining the equation of transport for the one particle distribution function $\epsilon(x,v,t)$ in the kinetic theory of plasma. It is noted that a finite description of the plasma distribution transport can be obtained by including those correlations which appear as the dielectric coefficient. (J.R.D.)

27012 (RISO-18(p.119-31)) MHD STABILITY. J. R. Bickerton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

A discussion of stability problems related to plasma and magnetic fields is presented. Aspects of stability under conditions in which the plasma and magnetic field are completely separated are considered. Effects of pinch are examined and 'firehose' and 'mirror' type instabilities are analyzed. (J.R.D.)

27013 (RISO-18(p.189-200)) MICROINSTABILITIES. Marshall N. Rosenbluth (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

A survey is presented of microinstability, described as one which is not derivable from the standard magnetohydrodynamic equations, that are obeyed for example by liquid metals, but which depends on the detailed microscopic equations for the plasma. (J.R.D.)

27014 (RISO-18(p.201-8)) INSTABILITIES FOR ANISOTROPIC PRESSURE. R. Lüst (Max-Planck-Institut für Physik und Astrophysik, Munich).

Methods by which improvements in standard magnetohydrodynamic equations can be developed to obtain a better description of plasma are discussed. The improved equations are used to investigate various instabilities which arise when the pressure is not isotropic. (J.R.D.)

27015 (RISO-18(p.237-48)) A STABILITY SURVEY. W. B. Thompson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The problem of the response of an equilibrium configuration to vanishingly small perturbations is considered. It is noted that if all disturbances oscillate or vanish as time increases, the system is stable. However, if any disturbance exists which grows with time, the system is unstable. A method of solution is given which reduces the problem from a dynamic to a static status, and sometimes a variational principle can be found so that the dynamical equations need not be solved. (J.R.D.)

27016 (RISO-18(p.263-71)) DIFFUSION ACROSS A MAGNETIC FIELD. R. Liist (Max-Planck-Institut für Physik und Astrophysik, Munich).

Problems of plasma diffusion across magnetic fields are discussed. Included are considerations of magnetic field decay times, diffusion of fully-ionized plasmas, and ambipolar diffusion. (J.R.D.)

27017 (RISO-18(p.285-300)) TRANSPORT PROCESSES IN THE PLASMA. W. B. Thompson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

A discussion and mathematical development of information on these processes is presented in sections on kinetic theory, hydrodynamics, and the origin of transport effects; classical kinetic theory; transport coefficients for near-equilibrium plasmas; turbulence and transport processes; and plasma turbulence. (J.R.D.)

27018 (RISO-18(p.301-12)) SYNCHROTRON RADIATION. Marshall N. Rosenbluth (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

Various radiations emitted by hot confined plasma represent a serious energy drain and an important diagnostic tool. The emissions are more serious with heavy ions but occur also with light ions. A discussion of radiation sources which occur in completely ionized hydrogen plasmas is presented. (J.R.D.)

27019 (RISO-18(p.347-65)) INTRODUCTION TO CONTROLLED THERMONUCLEAR RESEARCH. O. Kofoed-Hansen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø).

A review is presented of the basic principles of obtaining controlled thermonuclear power originating from other considerations than those directly involved in plasma physics. Problems of plasma devices concerned with nuclear cross sections for bremsstrahlung losses which impose conditions on temperature and on the product of density and confinement time which must be fulfilled are discussed. (J.R.D.)

27020 (RISO-18(p.431-41)) PINCH DYNAMICS. Marshall N. Rosenbluth (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

A review of pinch dynamics is presented. Also, a description is given of the structure of a magnetic piston moving into a low-temperature plasma at rest. (J.R.D.)

27021 (RISO-18(p.455-67)) CLASSICAL THEORY OF MHD-SHOCK WAVES. Carl F. Wandel (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø).

There are indications that when a disturbance is forced to propagate through a medium in excess of the normal speed of sound, it gives rise to localized abrupt changes in magnetohydrodynamic (MHD) properties. A review and development of MHD-shock wave theory is presented. Included are an analysis of basic equations, characteristic velocities, the Rankine-Hugoniot relations, the shock transition zone, and types of magnetically produced shock waves. (J.R.D.)

27022 (RISO-18(p.493-513)) HIGH ENERGY INJECTION. [PART] I. Albert Simon (Oak Ridge National Lab., Tenn.).

A description is presented of experimental programs and theory associated with creation of thermo-nuclear reactors by injection of energetic particles into containing geometries. Included are discussions on direct pumping, burnout of neutral atoms, over-all plasma pumping, neutral atom burnout in OGRA-type devices, and arc turnoff in the DCX. (J.R.D.)

27023 (RISO-18(p.515-27)) HIGH ENERGY INJECTION. [PART] II. P. Hubert (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses).

Aspects of high-energy injection are discussed. The emphasis is placed on a family of magnetic bottles having a small hole which is showered with a beam to attempt filling the bottle. Preliminary calculations indicate that the life of these particles is long enough to arouse hope as to their use. (J.R.D.)

27024 (RISO-18(p.557-611)) PLASMA WAVES LECTURE SERIES. Charles B. Wharton (California. Univ., Livermore. Lawrence Radiation Lab.).

A few specific experiments in the area of microwave diagnostics are described, and the basic techniques for study of the interactions between high-frequency electromagnetic waves and ionized media are outlined. (J.R.D.)

27025 (RISO-18(p.613-26)) PLASMA PROBING. Charles B. Wharton (California. Univ., Livermore. Lawrence Radiation Lab.).

Designs of various plasma probes are described. Included are discussions on single Langmuir probes, single probes with and without B fields, effects of plasma oscillations on I. C. single probe, I. E. single probe characteristics, design of double floating probes, double probes no B field, and resonant probes. (J.R.D.)

27026 (UCRL-6372) ELECTRIC AND MAGNETIC DISSOCIATION OF MOLECULAR IONS AND NEUTRAL ATOMS. John R. Hiskes (California. Univ., Livermore. Lawrence Radiation Lab.). June 9, 1961. Contract W-7405-eng-48. 41p.

For IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, Sept. 4-8, 1961.

The dissociation of molecular ions and neutral atoms by the Lorentz force provides a mechanism for trapping energetic particles in fusion machines without need for ionizing collisions on background gas molecules or arc discharges. At ion energies in the fusion range, magnetic dissociation is equivalent to electrostatic dissociation. The range of parameters of thermonuclear interest corresponds to effective electric fields up to the order 10^6 cm. The threshold fields for dissociating the successive vibrational levels of all isotopic mixtures of the hydrogen molecular ion, H_2^+, HD^+, HT^+, D_2^+, DT^+, T_2^+, are reported. For the uppermost levels of these (nonrotating) ions the threshold fields range from 0.6×10^5 to 0.9×10^5 cm. Rotational effects are discussed in detail. The presence of rotation J introduces J + 1 new thresholds for a particular vibrational level; these thresholds are distributed about the single threshold for the nonrotating ion. The lack of a stepwise dissociation can be interpreted as due to a superposition of contributions from rotational states up to J = 4 or 5. Methods are discussed for enhancing the populations of the uppermost vibrational levels of the hydrogenic ions. The bound vibrational state belonging to the antibonding electronic state of each of the H_2^+, D_2^+, and T_2^+ ions can be dissociated with fields of the order 10^4 cm; reactions populating these levels are discussed. The formation of neutral hydrogen or deuterium atom beams by the charge exchange reaction provides a population distribution covering all excited states. The equilibrium populations of the excited levels are sufficiently large that the dissociation by the Lorentz force competes favorably with the other dissociation processes. A 30 kev H atom moving in a 60 kgauss field is susceptible to dissociation down to the n = 8 and 9 levels; a 100 kev atom in the n = 6 level is dissociated by a 130 kgauss field. Containment experiments designed on the basis of these data are discussed. (auth)

27027 (UCRL-6377) CRITICAL CONDITIONS FOR SELF-SUSTAINING REACTIONS IN THE MIRROR MACHINE. Richard F. Post (California. Univ., Livermore. Lawrence Radiation Lab.). June 10, 1961. Contract W-7405-eng-48. 84p.

For IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, Sept. 4-8, 1961.

A study is made of the critical conditions necessary for achieving a self-sustaining stable fusion reaction in a mirror machine. Reaction cycles utilizing the DD, DT, and DHe^3 fusion reactions and the Li neutron capture reaction are considered. Energy production, energy losses, plasma micro-instabilities, injection methods, and magnet designs are examined. Parameters studied include the ion temperature and β (plasma pressure relative to magnetic pressure). It is suggested that low β values, which are necessary for stability, may be achieved by the use of cryogenic and superconducting magnet coils. Experiments are suggested for determining the validity of the calculated results. (T.F.H.)

27028 (UCRL-6385) PARTICLE MOTION ON MAGNETIC FLUX SURFACES IN "STABILIZED" AND HARD-CORE PINCHES. S. A. Colgate, H. P. Furth, C. W. Hartman, and R. L. Spoerlein (California. Univ., Livermore. Lawrence Radiation Lab.). June 12, 1961. Contract W-7405-eng-48. 27p.

For IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, Sept. 4-8, 1961.

The stability and particle confinement properties of axial-field-centered and hard-core linear pinches are studied. A weak, externally produced electron beam is passed along the pinch discharge, in order to determine the time-varying properties of the magnetic surfaces of various pinch configurations. Analysis of the emerging electron beam demonstrates the effects of turbulence on diffusion and particle losses. The applications of the results to a toroidal hard-core pinch are discussed. (T.F.H.)

27029 (UCRL-9612) HYDROMAGNETIC IONIZING WAVES. Wulf B. Kunkel and Robert A. Gross (California. Univ., Berkeley. Lawrence Radiation Lab.). May 16, 1961. Contract W-7405-eng-48. 39p.

It is possible to generate plasma by passing a discharge between electrodes arranged such that the current is forced to flow across an initial strong magnetic field. The magnetic induction due to the discharge causes a bending of the original field. If the discharge is operated with a low-impedance current source, electric breakdown starts in a limited region near the current-input connections and propagates as a well-defined front in the manner of a hydromagnetic shock wave. Such a shock is usually compressive, i.e. the sudden increase in temperature and ionization is usually accompanied by an abrupt onset of both transverse and longitudinal components of plasma flow. Consequently the front must be followed by a rarefaction wave in which the longitudinal flow is brought to rest. This phenomenon is analyzed as a one-dimensional single-fluid hydromagnetic problem, neglecting dissipation behind the wave. The assumptions are made of zero conductivity in front and thermodynamic equilibrium behind the wave. In the limit of essentially complete ionization behind the front, the problem can be solved analytically if the transverse magnetic field there remains small compared with the longitudinal field. In this case, the front velocity, plasma temperature and density, and the electric field behind the wave, as well as the structure of the rarefaction wave, can be expressed as simple functions of the initial magnetic field, the discharge current, the ionization energy, and the initial gas density. Over a certain range of operating conditions, the electric field is relatively independent of the driving current and is primarily determined by the ionization energy per unit mass of the gas. Conditions are derived for noncompressive waves, hence also for production of uniform plasma. (auth)

27030 (JPRS-R-669-D) MEASUREMENT OF SOME OF THE CHARACTERISTICS OF A STRONGLY IONISED PLASMA. G. Vincent, F. Dumez, and M. Malbee. Translated from Ann. radioélec., No. 54, 326-38(Oct. 1958). 21p.

The properties of plasmas produced by pulsed discharges in toroidal configurations are studied at temperatures on the order of 10^{5}°K. Methods for excitation of the plasma (H at 10 to 10^{3} μm Hg) are outlined. The plasma properties are measured by classical methods, and by microwave techniques at a wavelength of 8.2 mm. The properties calculated include the electronic density, the degree of ionization, the time duration of the discharge pulse, and the microwave reflecting properties. (T.F.H.)

27031 (NP-tr-728) THE FLOW OF VISCOUS CONDUCTING GAS IN A TRANSVERSE MAGNETIC FIELD WITH HEAT EXCHANGE. E. P. Zimin. Translated from Priklad. Mat. i Mekhan., 25: 381-2(1961). 3p.

The solution for the planar flow of a gas in a transverse magnetic field, with heat exchange, was generalized for the case of viscous dissipation. The flow of a liquid between infinite non-conducting plates with a uniform magnetic field applied normal to them was examined. (M.C.G.)

27032 NEW METHOD OF CONFINEMENT IN PLASMAS. EXAMINATION OF THE PRINCIPLE OF OPERATION. Marcel Haegi (Université, Geneva). Arch. sci. (Geneva), 13: 508-22(Oct.-Dec. 1960). (In French)

Numerical examples are given of the calculation of the density at the center, fusion probability at the center, probability of collision near the center, stability, and diamagnetic limitation for a model in which all positive ions have orbits passing through the same line. The number of particles per unit volume for $\rho \to 0$ approaches infinity, almost all collisions take place in this region, and the velocity in this region is radial before collision. (J.S.R.)

27033 THE CORRELATIONS OF TEMPERATURE IN THE EXPRESSION OF THE CONDUCTIVITY TENSOR OF A PLASMA IN A CONSTANT MAGNETIC FIELD. Daniel Quemada. Compt. rend., 252: 3556-8(June 5, 1961). (In French)

The hypothesis of an anisotropic pressure leads, by taking a more general adiabatic condition ($\vec{\nabla} \cdot \vec{\vec{Q}} = 0$), to an expression of the conductivity tensor which takes into consideration the effects of temperature. This expression is in excellent agreement with those obtained recently by different authors. (tr-auth)

27034 ELECTROSTATIC INSTABILITIES IN SLIGHTLY INHOMOGENEOUS PLASMAS. E. Frieman and A. Pytte (Princeton Univ., N. J.). Phys. Fluids, 4: 1026-31(Aug. 1961). (MATT-50)

Two approximate methods are presented for studying electrostatic instabilities in a spatially inhomogeneous plasma with no applied external magnetic field. The first is a perturbation procedure to be applied when the deviations from uniformity are small. The second is similar to a W. K. B. procedure to be applied when the density is a slowly varying function of position. Stability criteria are derived for both methods. (auth)

27035 RAYLEIGH-TAYLOR INSTABILITY IN A STABILIZED LINEAR PINCH TUBE. D. J. Albares, N. A. Krall, and C. L. Oxley (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 4: 1031-6(Aug. 1961). (GA-1962)

Kerr cell photographs through a mesh anode have shown growing flute patterns on the interior luminous surface of the plasma cylinder. These appeared when the pressure of the enclosed axial field reversed the initial inward acceleration, as is expected for the accelerational hydromagnetic analog of the Rayleigh-Taylor instability. The measured growth rates ranged from about one-half to the full value predicted by simple theory. This agreement extended over a range of operational tube conditions. As predicted, application of an interior stabilizing field from a central wire erased the visible fluting. (auth)

27036 STABILITY OF A CURRENT-CARRYING PLASMA. Ira B. Bernstein and Russell M. Kulsrud (Princeton Univ., N. J.). Phys. Fluids, 4: 1037-9(Aug. 1961). (MATT-66)

The critical current is obtained for the onset of ion wave instability in the experimentally interesting case of a current-carrying plasma with an electron distribution function given by the conductivity theory of Spitzer and Härm. The results are presented in a form suitable for comparison with experiment. (auth)

27037 END-LOSSES FROM MIRROR MACHINES. George F. Bing and John E. Roberts (Univ. of California, Livermore). Phys. Fluids, 4: 1039-46(Aug. 1961).

Theoretical calculations are described, based on the Fokker-Planck equation, of the loss of plasmas from the ends of simple magnetic mirror machines. The plasma losses are described in terms of the evolution in time of distribution functions. The effects on the loss rate that arise from varying the mirror ratio of the machines and from varying the shape of the initial distribution function of the plasma are discussed. (auth)

27038 STABILITY OF A PLASMA WITH A CONTINUOUS DENSITY DISTRIBUTION. B. Lehnert (Royal Inst. of Tech., Stockholm). Phys. Fluids, 4: 1053-4(Aug. 1961).

Plasma stability is discussed for a plasma region of density n assumed to be separated from a region of density $n(1-\vartheta)$, where $0 < \vartheta < 1$. A magnetic field combined with a gravitational field causes ion drift, in turn producing a charge separation, an electric field, and an electric drift. The angle of perturbation is thus changed. A rapid relative drift velocity provides a scrambling mechanism which stabilizes the system in some cases. The growth rates for unstable perturbations are found to be much smaller than those obtained in the case discussed by Rosenbluth and Longmire (NSA 11: 8061, NSA 15: 16583). (L.N.N.)

27039 ELECTRON-HEAVY PARTICLE COLLISION MODEL IN A PLASMA. Toyaki Koga, John G. Everton, and Paul C. Wilber (Univ. of Southern California, Los Angeles). Phys. Fluids, 4: 1057-8(Aug. 1961).

Although the usual concept of binary collision is not valid, strictly speaking, the "binary collision" may, in an approximate sense, be separated from "group interaction" if $\frac{3}{2}\,kT > e^2 n^{1/3}$, where $\frac{3}{2}\,kT$ is the average energy of motion of a particle, e the electronic charge, and n the number density of charged particles. Assuming that the heavy particle has a much greater mass and smaller speed than the electron and may be an ion of neutral molecule, a collision model is proposed. Simple, ionization, and recombination collisions are considered. (L.N.N.)

27040 RADIATION IN A PLASMA. I. ČERENKOV EFFECT. Marshall H. Cohen (Observatoire de Meudon, Seine-et-Oise, France). Phys. Rev., 123: 711-21(Aug. 1, 1961).

The linearized plasma equations contain an isotropic pressure term, plus extra source terms J^s and ρ^s in the Maxwell equations. The fields of (J^s,ρ^s) can be decomposed into two modes. The electromagnetic (EM) mode has all the magnetic field and no charge accumulation; it is the ordinary EM field of (J^s,ρ^s) in a dispersive medium of relative dielectric constant $\epsilon_r = 1 - (\omega_p/\omega)^2$. The plasma (P) mode has all the charge accumulation and no magnetic field; at great distances from the source, it becomes a longitudinal (radial) plasma wave with the usual dispersion relation for plane plasma waves. Various potentials for the EM and P modes are given by the inhomogeneous Klein-Gordon equation. The fields of a uniformly moving charged particle are found by a Lorentz transformation. When $(u/v_0) < 1$ (u = particle velocity, v_0 = rms thermal velocity), the EM and P fields are exponentially screened outside oblate spheroids foreshortened in the direction of motion. When $(u/v_0) > 1$, the P field exists only within the Mach (Čerenkov) cone trailing the particle. The frequency and angular spectra of the Čerenkov radiation are found, and the total radiated energy is found by assuming an arbitrary high-frequency cutoff due to Landau damping. The expression for total radiated energy agrees with that given by Pines and Bohm, except for the logarithmic terms. (auth)

27041 ELECTRIC-FIELD-INDUCED ANISOTROPIES IN AN INHOMOGENEOUS PLASMA. Lewis Wetzel (Brown Univ., Providence). Phys. Rev., 123: 722-6(Aug. 1, 1961).

It is shown on the basis of the Boltzmann equation that in the absence of a d-c magnetic field, an electric field alone can produce anisotropies in electron diffusion and conductivity in a weak inhomogeneous plasma. These anisotropies have their origin in the a-c component of the electron density gradients. Electron diffusion is reduced in the direction of the field, while the induced a-c current acquires an additional component in the direction of the gradient of the a-c electron density. This component will in general lie in a direction different from that of the exciting field. Although these effects are usually small, they may become significant under suitable circumstances. (auth)

27042 STABLE PLASMA CONFINEMENT BY MULTIPOLE FIELDS. T. Ohkawa and D. W. Kerst (General Atomic Div. of General Dynamics Corp., San Diego). Phys. Rev. Letters, 7: 41-2(July 15, 1961).

A multipole field plasma confinement device is described that can be used in either a linear or a toroidal configuration. It consists of an even number of current carrying rods evenly spaced around the inner face of an outer current carrying element. This inner face is cylindrical (or toroidal). The rods fit, without touching, into smooth indentations in the face of the outer conductor. No B_z field is required. The containment time is long compared to the times in which other processes affect the plasma. (T.F.H.)

27043 EXPERIMENTAL EVIDENCE FOR QUANTIZED FLUX IN SUPERCONDUCTING CYLINDERS. Bascom S. Deaver, Jr. and William M. Fiarbank (Stanford Univ., Calif.). Phys. Rev. Letters, 7: 43-6(July 15, 1961).

The magnetic flux trapped inside hollow superconducting tin cylinders, upon removal of an applied magnetic field B, is measured as a function of B. The cylinders are plated on copper wires, with thicknesses of 1.5 and 5μ. The trapped flux is found to be quantized in units of hc/2e, and jumps between the quantized flux levels are found to occur at relative B values of 1, 3, 5, and 7. (T.F.H.)

27044 THEORETICAL CONSIDERATIONS CONCERNING QUANTIZED MAGNETIC FLUX IN SUPERCONDUCTING

CYLINDERS. N. Byers and C. N. Yang (Stanford Univ., Calif.). Phys. Rev. Letters, 7: 46-9(July 15, 1961).

It is observed that the magnetic flux ϕ inside a cylindrical superconducting shell is quantized in units of hc/2e. This quantization is shown to follow from the requirements that the magnetic field B inside the superconductor = 0 and that a pair correlation exists between the electrons in the superconductor. The quantization is shown to result from the fact that the superconductor wave function ψ is related to ϕ by a function of the form $\psi = \psi_{B=0} \exp(i\pi\phi \cdot 2e/ch)$. (T.F.H.)

27045 MAGNETIC FLUX THROUGH A SUPERCONDUCTING RING. Lars Onsager (Univ. of California, La Jolla). Phys. Rev. Letters, 7: 50(July 15, 1961).

The observed quantization of magnetic flux enclosed in a superconducting annulus is discussed. It is shown that the size of the quantum unit (hc/2e) implies a pairing effect between the electrons. The suggestion that flux quantization is an intrinsic property of electromagnetic fields is analyzed. The effect of flux quantization on the observed fact, that the magnetic field in a superconductor = 0, is discussed. (T.F.H.)

27046 EXPERIMENTAL PROOF OF MAGNETIC FLUX QUANTIZATION IN A SUPERCONDUCTING RING. R. Doll and M. Näbauer (Kommission fur Tieftemperaturforschung der Bayerischen Akademie der Wissenschaften, Herrsching/Ammer, Ger.). Phys. Rev. Letters, 7: 51-2(July 15, 1961).

The magnetic flux frozen into a cylindrical superconducting lead shell, after removal of a magnetic field B, is measured as a function of B. It is found that the trapped magnetic flux is quantized, in units of about 40% of hc/e. (T.F.H.)

27047 THE MICROFIELD IN PLASMA. K. Hunger and R. W. Larenz (Technische Hochschule, Hanover). Z. Physik, 163: 245-61(1961). (In German)

By taking full account of the Coulomb interaction and energy conservation, the probability distribution of the electric and magnetic microfield in an ionized gas is calculated. A Gaussian distribution results instead of the hitherto used Holtsmark function and its variants which exhibit certain deficiencies. The mean square electric field is found to be proportional to the temperature, in analogy to the Nyquist formula. The probability of finding an atomic charge in the vicinity of another is eatablished. With this, the time correlation function of the microfield and an average of the correlation time is deduced. Applications to the theory of transport phenomena and spectral line broadening are briefly discussed. (auth)

27048 PLASMA DISCHARGE DEVICE. (to U. S. Atomic Energy Commission). British Patent 874,381. Aug. 10, 1961.

A pinch device is designed for stabilizing the pinch discharge. In the device, a high-density plasma is established between electrodes whereby the plasma induces a magnetic field laterally constricting itself, and magnetic fields are used to limit plasma constriction at the ends. (D.L.C.)

27049 IMPROVEMENTS IN APPARATUS FOR GENERATING THERMONUCLEAR ENERGY BY FUSION OF ATOM NUCLEI. Peter Bo Lehnert. British Patent 874,500. Aug. 10, 1961.

A thermonuclear reactor is described which avoids the disadvantages entailed in magnetic mirror machines and stellarators. In this reactor, a plasma is injected from an ion source into a receptacle containing a ring-shaped electrical conductor. The ring conductor is energized to form a toroidal magnetic field, and a second magnetic field is superimposed on the first to result in a net toroidal magnetic field with helical field lines, causing the plasma to follow a helical path around the ring conductor. (D.L.C.)

27050 APPARATUS FOR THE DENSIFICATION AND ENERGIZATION OF CHARGED PARTICLES. (to U. S. Atomic Energy Commission). British Patent 875,938. Aug. 23, 1961.

An apparatus for the densification and energization of charged particles, e.g., a plasma, is designed which comprises a succession of connected compression chambers of graded size and which may be called a linear multiple-zone Pyrotron. Magnetic field generating means are arranged around the chambers in such a way that a unidirectional field of increasing intensity and a pulsed field of decreasing intensity are provided in the direction of decreasing chamber size. (D.L.C.)

27051 THERMONUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 875,941. Aug. 23, 1961.

A thermonuclear reactor of the stellarator type is designed with means for establishing a circular magnetic surface within the stellarator tube to increase its efficiency. (D.L.C.)

Shielding

27052 (AFBSD-TN-61-7) RADIATION SHIELDING OF SPACE VEHICLES BY MEANS OF SUPERCONDUCTING COILS. Research Note 224. R. H. Levy (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Apr. 1961. Contract AF04(647)-278. 29p.

The possibility of using magnetic fields for shielding is discussed. In general, it appears that adequate shielding requires magnetic fields of such strength that enormous quantities of power would be required to maintain them making the whole method impractical. Howevèr, Dow points out that superconductors might be used to advantage, and it is shown in some detail that this is indeed possible, especially in view of the recent spectacular advances in superconductors achieved at Bell Telephone Laboratories, although subject to some reservations. Curves are presented showing the estimated weights of the shields required to protect various volumes against protons of various energies. The curves compare the weights of solid shields using H_2O and magnetic coil devices. The latter are considerably lighter than the former when either high-energy particles or large volumes or both are considered. However, they are still very massive devices, nearly all the mass being coil structure. (auth)

27053 (BMI-1493) FAST-NEUTRON AND GAMMA SPECTRUM AND DOSE IN BERYLLIUM OXIDE. Raymond W. Klingensmith, Richard G. Jung, William A. Lindgren, Harold M. Epstein, and Joel W. Chastain, Jr. (Battelle Memorial Inst., Columbus, Ohio). Jan. 11, 1961. Decl. May 9, 1961. Contract W-7405-eng-92. 30p.

Neutron and gamma penetrations through and behind BeO were measured. Neutron spectra measurements by threshold foil techniques indicated practically no change in the fast-neutron spectrum above 2.5 Mev in BeO. Thus, beryllium appears to lie in the transition region between the very light elements that harden a fission spectrum and the heavier elements that soften it. The ratio of fast-neutron fluxes below and above 2.5 Mev increased rapidly with distance through the BeO. Information indicated that the flux peaked at around 1.5 to 2.5 Mev. In this energy range the scattering cross section of beryllium goes through a minimum. Fast neutron dose measurements through BeO were compared with those calculated by the moments method. The removal cross section for BeO was determined from fast-neutron dose rates measured in the water behind the slabs. Gamma dose rates were measured through and be-

hind the BeO slabs with a carbon chamber. The gamma dose rate decreased with a relaxation length of about 11 cm near the source. The relaxation length increased with distance through BeO, indicating spectrum hardening. Gamma spectra were measured at intervals behind BeO slabs with a collimated sodium iodide crystal. The 6.8 and 3.41 Mev beryllium capture gamma rays became dominant as the distance through the BeO increased. Thermal flux was measured through and behind the BeO with both a fission chamber and gold foils. Thermal flux distributions for these tests were calculated by a multilevel diffusion code. The calculations differ from the experiment at large penetration distances through BeO. (auth)

27054 (HW-66861) GAMMA SHIELDING CALCULATIONS FOR SLAG AND CRUCIBLE FRAGMENT HANDLING–PLUTONIUM RECLAMATION FACILITY, PROJECT CAC-880. H. A. Moulthrop (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 27, 1960. 10p.

An analysis of gamma data taken on slag and crucible containers in the plutonium reclamation facility is presented together with the shielding required for a dose rate of less than 0.5 mr/hr in the vicinity of this equipment. (D.L.C.)

27055 (HW-69533) FISSION PRODUCT RADIATION AND SHIELDING CALCULATIONS. H. H. Van Tuyl (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 16, 1961. Contract AT-(45-1)-1350. 62p.

Calculations relating to radioactive decay by beta and gamma emission are discussed with special emphasis on processes which are often ignored but which become important when dealing with purified fission products. These include beta spectra analyses to permit accurate evaluation of average beta energies, bremsstrahlung production in beta decay, and internal conversion in gamma decay. Calculations of fission product production and dose rates are also described. The attenuation of both primary and secondary gamma rays is discussed, and data are presented which permit accurate estimation of gamma dose rates from point sources, including both primary attenuation and dose build-up factors. Formulas for extending these calculations to other simple geometries are given. (auth)

27056 (HW-69789) APPROXIMATE SHIELDING CALCULATIONS. E. A. Coppinger (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 31, 1961. Contract AT(45-1)-1350. 21p.

Equations and nomograms are given for finding approximate gamma shielding requirements. The actual source is replaced by a point source, and the dose rate from the shielded point source is found as a function of the source strength, gamma energy, source-receptor distance, shield thickness, and shield attenuation factor. Attenuation factors are presented for ordinary concrete, magnetite concrete, lead, iron, water, and high-density glass. The method may be used for sources with several gamma energies. (T.F.H.)

27057 DETERMINATION OF THE EFFECTS OF SPHERICAL HOLES IN THE SHIELDING MEDIA ON THE GAMMA FLUX. Emin Beynam (AEG-Kernenergieanlagen, Frankfurt am Main). Atomkernenergie, 6: 233-7(June 1961). (In German)

The flux increase or decrease caused by the holes in shielding media is computed with the aid of fictitious point sources. An example is given for spherical air bubbles in lead. The extension possibilities of the method are discussed. (auth)

27058 IMPROVEMENTS RELATING TO RADIATION SHIELDING WALLS THAT CAN BE TAKEN TO PIECES. (to Forges and Aciéries du Saut du Tarn). French Patent 1,212,459. Mar. 24, 1960.

A radiation shielding wall is constituted by a pile of shielding elements taking the form of symmetrically shaped pieces. These pieces have shoulders and depressions and are fitted one on top of the other with the shoulders of any one piece resting in the depressions of adjacent pieces. The shaped pieces may have an H or I section. Between these pieces, other pieces of a second kind may be intercalated, the latter having a specific gravity or a composition other than the former. These pieces of a second kind may have rectangular cross-sections. (NPO)

Theoretical Physics

27059 ON THE DAMPING PROBLEM IN QUANTUM THEORY. B. Mielnik (Inst. of Theoretical Physics, Univ. of Warsaw). Bull. acad. polon. sci., Ser. sci., math., astron. et phys., 9: 389-93(1961). (In English)

27060 ANALYTIC PROPERTIES AND RESCATTERING CORRECTION TO THE BORN APPROXIMATION FOR TRANSITION MATRIX ELEMENTS. B. Bosco (Stanford Univ., Calif.). Phys. Rev., 123: 1072-6(Aug. 1, 1961).

Analytic properties of a matrix element of a general operator between a bound state and a scattering state are studied in the framework of Schrödinger theory. It is shown that the singularities of such a matrix element are easily inferred from those of the Born approximation. Finally, using the fact that the possible singularities which are not contained in the Born approximation are located far apart from those included in the lowest approximation, a simple formula is derived which allows one to obtain the rescattering correction to the Born approximation using the phase shifts explicitly. (auth)

27061 EXPERIMENTAL DETECTION OF TRANSITION RADIATION. H. Boersch, C. Radeloff, and G. Sauerbrey Universität, Berlin). Phys. Rev. Letters, 7: 52-4(July 15, 1961).

The transition (Lilienfeld) radiation emitted by an electron incident on a metal is studied for W, Ta, Mo, Ti, Pt, Ag, Ni, Al, Cu, and Cs. The radiation is found to be independent of the target temperature and gas pressure. The radiation is almost completely plane polarized, and forms a continuum. The radiation intensity is measured as functions of the target metal, emission angle, wavelength, electron energy, and current density. (T.F.H.)

27062 THE APPLICATION OF GROUP THEORY IN PHYSICS. G. Ya. Lyubarskiĭ. Translated from the Russian by Stevan Dedijer. New York, Pergamon Press, 1960. 386p.

Foundations of physical group theory are expounded. Specific groups are discussed as examples, and the problem of representation of groups is studied. Physical systems and processes are investigated, including crystals, second-order phase transitions, small oscillations of symmetrical systems, absorption and Raman scattering of light, nuclear reactions and scattering matrices. Representations of the rotation, full orthogonal, and Lorentz groups are given particular attention. Infinite groups are examined. Discussions are given of the Clebsch-Gordon and Racah coefficients, the Schrodinger equation, relativistically invariant equations, and Euclidean-group-invariant equations. (T.F.H.)

27063 DISPERSION RELATIONS AND THE ABSTRACT APPROACH TO FIELD THEORY. Lewis Klein, ed. International Science Review Series, Volume I. New York, Gordon and Breach, Publishers, Inc. 1961. 285p.

Developments in abstract field theory are reviewed. This theory is a pure S-matrix type theory in which details of interactions are ignored. Fifteen papers are presented, covering formulations of quantum field theories; properties of propagation functions, renormalization constants, vacuum expectation operators, and dispersion relations in quantum field theories, and integral representations of causal commutators in quantum field theories. The analyticity of the vacuum expectation values is studied. The bound state problem is considered. The validity of the Mandelstam representation of the scattering amplitude is investigated, and the analyticity properties of scattering amplitudes are outlined. A theoretical calculation of the π-nucleon scattering amplitude is carried out. The high energy total cross sections of nucleons and antinucleons are compared. (T.F.H.)

REACTOR TECHNOLOGY

General and Miscellaneous

27064 (AD-252282) DEFECTIVE FUEL ELEMENT DETECTION AT THE SM-1 NUCLEAR POWER PLANT. Period covered by this report, October 8, 1960 through November 5, 1960. R. A. Purple and J. R. Mullaly (Corps of Engineers. Nuclear Power Field Office, Fort Belvoir, Va.). 62p. (OSB-12)

On 5 October 1960, shortly after reaching full power (10 Mwh), it was discovered that the primary coolant gross iodine activity had increased to more than 20 times the normal full power activity. This was indicative of a defective fuel element. Subsequent testing (flux tilting) located the section of the core having the defective element. Tests performed on individual fuel elements located the defective element which was then removed. The gross iodine activity upon return to full power was normal, thereby proving the validity of the testing. (auth)

27065 (ANL-6092) THE DESIGN AND CONSTRUCTION OF THE EBR-II INITIAL FUEL LOADING FACILITY. James E. Ayer and Arthur B. Shuck (Argonne National Lab., Ill.). June 1961. Contract W-31-109-eng-38. 23p.

The need for the first core for EBR-11 resulted in the design and construction of the Initial Fuel Loading Facility for this reactor. The plant was built to provide the required initial loading, to train personnel, and to test prototype equipment for the remote reprocessing of fuel materials in the EBR-II Fuel Cycle Facility. The facilities include: remotely manipulated melting, casting, and pin processing equipment, a degreaser, hoods and their atmospheric control system, a gas-purification system, fuel-element-assembly equipment, mold-preparation and balance room, bonding furnaces, a maintenance shop, and a change area. (auth)

27066 (CEA-1950) TRANSISTOIRES DE PERIODE LIES A UNE VARIATION DE REACTIVITE. (Periodic Transients Linked to a Variation in Reactivity). J. Furet and J. Weill (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 25p.

A study is made of the influence of the transient, linked to a variation in reactivity, on the measurement of the period, this measurement being made from the logarithmic differential of the power and defined by $(1/T) = (1/p) \cdot (dp/dt)$. The adjustment of the thresholds of period safety is often incompatible with the velocities of liberation of reactivity. A compromise is then necessary between the speed of response of the periodimeter and the speed with which the reactivity is liberated. This makes it necessary to have rapid security devices for the power levels in the piles in which the speeds of liberation of the reactivity are high. (auth)

27067 (CF-61-4-71) PREPARATION AND SPECIFICATIONS OF MINIATURE FERMI REACTOR CORE B FUEL SPECIMENS FOR IRRADIATION TESTING. J. H. Cherubini and R. C. Williams (Oak Ridge National Lab., Tenn.). Apr. 21, 1961. 22p.

The preparation of miniature plate specimens containing dispersions of 33.2 wt.% UO_2 in type 347 stainless steel for irradiation testing is described. These plates simulate the prototype roll-bonded stainless steel-clad composite plates intended for the Core B fuel element of the Enrico Fermi sodium-cooled reactor. The significant characteristics of the fabricated irradiation specimens are tabulated. The samples will be used to determine the irradiation behavior of 33.2 wt.% UO_2 at temperatures of about 1150°F in controlled capsule tests in the Materials Testing Reactor. (auth)

27068 (CF-61-7-60) AFTER SHUTDOWN COOLING REQUIREMENT IN THE HFIR. Neil Hilvety (Oak Ridge National Lab., Tenn.). July 20, 1961. 9p.

In order to insure against damage to the reactor in the event of a power failure, it is recommended that emergency forced circulation be provided for a period of about one hour after shutdown. After about one day's decay time, natural circulation cooling on the outside surface of a single fuel annulus should provide sufficient cooling to prevent meltdown. Maximum possible heatup rates at shorter decay times are indicated. (auth)

27069 (CF-61-7-82) MINUTES OF THIRD MEETING OF REACTOR DECONTAMINATION INFORMATION EXCHANGE GROUP AT ORNL, JUNE 1-2, 1961. A. B. Meservey (Oak Ridge National Lab., Tenn.). July 24, 1961. 29p.

The third semiannual meeting of the AEC-sponsored Reactor Decontamination Information Exchange Group was held at ORNL during June 1 and 2, 1961. Nine reactor installations, including Chalk River, were represented by personnel from their decontamination research teams. The decontamination research at each installation during the last six months is summarized. (auth)

27070 (CRRL-917) REACTOR LOOPS AT CHALK RIVER. R. O. Sochaski (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 25, 1961. 94p. (AECL-1273)

The nine in-reactor loops located in and around the NRX and NRU reactors are described broadly. Tables outlining some loop specifications and simplified flowsheets are included. Each loop is classified into two categories, the main loop circuit and the auxiliary circuit, and descriptions are given of each circuit's components. These components, in part, are comprised of the main loop pumps, test section, loop heaters, loop coolers, delayed-neutron monitors, surge tank, Dowtherm coolers, and loop piping. (D.L.C.)

27071 (CVNA-80) FAILED FUEL ELEMENT DETECTION AND LOCATION SYSTEM ANALYSIS AND DESCRIPTION, CAROLINAS-VIRGINIA TUBE REACTOR. A. Andonedis (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). June 1961. Contract [AT(30-1)-2289]. For Carolinas-Virginia Nuclear Power Associates, Inc., Charlotte, N. C. 68p.

The failed fuel element detection and location system for the Carolinas-Virginia tube reactor is described. Analysis of the system indicates that at least three defective fuel rods existing simultaneously can be located in the pressure tubes of the reactor. A tabulation includes the signal activity present in the effluent from each pressure tube and the background activity in the main coolant for each fission product isotope which emits gamma photons. The calculations are based on the CVTR Reference Design II system parameters. (auth)

27072 (HW-61543) DESIGN CRITERIA FOR PRTR HIGH PRESSURE LOOP, PROJECT CAH-841. J. C. Fox, M. T. Jakub, and W. S. Kelly (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 15, 1959. 127p.

The design is described of the PRTR high pressure loop experimental assembly for use in testing the feasibility of

reactor cooling systems utilizing high pressure water or steam as the coolant. The facility is based on a reactor concept employing internally cooled fuel elements with a multipass supercritical pressure cooling system. (J.R.D.)

27073 (KAPL-2000-14) REACTOR TECHNOLOGY REPORT NO. 17–ENGINEERING. (Knolls Atomic Power Lab., Schenectady, N. Y.). July 1961. Contract W-31-109-Eng-52. 80p.

Power Plant Component Design. Analysis was carried out on the pass partition plate of a U-tube steam generator to determine its vibration response when an external sinusoidal motion is imposed on the whole generator. Irradiation Testing. A program and equipment for interim examination of irradiation test specimens during the irradiation schedule are described. An in-pile creep irradiation test capsule which provides continuous measurement of the change in gage length of a specimen under a steady tensile load is described. Heat Transfer and Fluid Flow. An analysis of free convection heat flow was made for the case of a vertical annulus surrounded by a thick-walled cylinder and its application to head temperature distribution discussed. An approximate solution is developed for the quasi-steady-state two-way convection flow in an inclined matrix of uniform volumetric heat generation bounded by a cylindrical enclosure and by a plenum heat sink above. Miscellaneous. The forces leading to bellmouthing of threaded joints (failure by loss of thread engagement) are considered. A correction is presented for previously published results on transient thermal stresses in thin cylinders. Definitions are given for concepts involved in multidegree vibrating systems and their effective properties derived. (D.L.C.)

27074 (NDA-2164-2) AN EVALUATION OF U^{233}–THORIUM FUELS FOR FAST BREEDER APPLICATION. Ralph Hankel and Arthur J. Goodman (United Nuclear Corp., White Plains, N. Y.). Aug. 15, 1961. Contract AT(30-1)-2303. 85p.

An investigation of the breeding potential, energy costs, and long-term nuclear effects of a number of 300-Mwe reactors using alternate types of U^{233}–Th fuels and fuel element configurations was performed as part of an evaluation of fast U^{233}–Th breeder reactors. The fuel types evaluated were metal alloy, sponge, oxide, oxide-BeO mixtures, carbide, and cermet. Rods, plates, and annuli were the geometric shapes investigated. Over-all system doubling times, for a set of assumed reference conditions, ranged from 19.7 years for carbide fuel to 28.6 years for metal alloy fuel. Fuel cycle costs varied from 3.5 mill/kwh for oxide fuel to 7.5 mill/kwh for metal fuel. These doubling times and fuel costs are based on the best judgment of the near term burnup capability of the fuels considered. A carbide design with a fuel cost of 3.7 mill/kwh and a doubling time of 19.7 years was selected for further detailed evaluation. Of the geometric configurations studied, the rod type element led to lower fuel costs than either plates or annuli. The addition of 25% BeO to oxide fuel in order to increase power density lowered the system doubling time from 27.6 years to 24.3 years, but increased fuel costs from 3.53 mill/kwh to 3.86 mill/kwh. The long-term nuclear effects on breeding potential, reactivity, control requirements, and fuel handling were considered for each fuel material. No fuel material demonstrated long-term characteristics which would affect its feasibility of operation; furthermore, the effects for the several fuel materials are sufficiently similar as not to influence the selection of a preferred fuel. (auth)

27075 (NP-10508) SWEDISH REACTOR LEAK AND HYDROSTATIC TESTS. Major Report 413. H. L. MacGregor (ACF Industries, Inc. American Car and Foundry Div., Berwick, Penna.). Sept. 4, 1958. 64p.

Freon leak tests and instrumented hydrostatic tests were performed on a reactor intermediate tank assembly constructed for a Swedish 30-Mw research reactor. No leaks were found, and only one instrumented location showed a stress above the specified 9500 psi minimum yield strength of the material. (D.L.C.)

27076 (NYO-2691) NUCLEAR FUEL RESEARCH FUEL CYCLE DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT, OCTOBER 1 TO DECEMBER 31, 1960. (Olin Mathieson Chemical Corp., [Niagara Falls, N. Y.]). Feb. 10, 1961. Contract AT(30-1)-2374. 27p.

Uranium Oxide Fuel. A laboratory scale process was developed for fabricating UO_2 pellets by low-temperature sintering in N_2. The relationship between pellet density and sintering temperature was established. A density of 95% of theoretical was attained at 1200 to 1300°C with a minimum initial O/U ratio of 2.25. At least a 1-hr soaking in H_2 at 1200 to 1300°C is required to remove excess O_2. It was found that ~3000 ppm fluoride seriously inhibits sintering and that oxidation-reduction cycling of the contaminated oxide restores the original activity. A two-month corrosion test on sintered UO_2 pellets in 680°F water was completed without any evidence of corrosion. Uranium Carbide. It was found that the C content of methane-produced UC can be reduced from 4.8 to 4.4 wt % by reducing the carburizing temperature from 750 to 650°C. Some results are presented using propane as a carburizing medium. The propane-produced UC could be compacted at 35 and 50 tsi with 3 wt % cetyl alcohol as a binder-lubricant. Results are presented for UO_2–graphite pellets reacted prior to melting and pellets charged directly into the skull furnace without being previously reacted. (D.L.C.)

27077 (ORNL-3103) DIMENSIONAL BEHAVIOR OF THE EXPERIMENTAL GAS-COOLED REACTOR FUEL ELEMENT AT ELEVATED TEMPERATURES. W. R. Martin and J. R. Weir (Oak Ridge National Lab., Tenn.). Aug. 2, 1961. Contract W-7405-eng-26. 48p.

The Experimental Gas-Cooled Reactor (EGCR) fuel assemblies consist of a cluster of seven fuel elements contained in a graphite sleeve. Each element is composed of hollow cylindrical UO_2 pellets encapsulated in a type 304 stainless steel tube. The dimensional behavior of the fuel element was determined in an apparatus which simulated the thermal conditions predicted for the EGCR. Particular emphasis was placed on determining the relationship between the fuel temperature and axial expansion, the radial expansion characteristics of the fuel, the effect of cladding and fuel interaction on heating and subsequent cooling, the effect of rapid temperature excursions on the degradation of the fuel, and accumulative effects in the fuel element due to thermal cycling. An element that contains a radial gap between the cladding and the fuel pellet was found to respond to thermal cycling in the same manner that the individual components would react if subjected to the same thermal conditions and tested separately. Both the axial and radial expansion of the fuel pellet are very nearly a function of the maximum central temperature. The axial expansion of the fuel pellet column can be reduced appreciably at elevated temperatures by "dishing" the ends of the pellets. The pellets fracture radially and circumferentially upon heating, but redistribution of the fuel does not occur. If no radial gap exists between the fuel and the cladding, the expansion characteristics of the element during thermal cycling are a function of the fuel temperature, cladding temperature, and the external pressure exerted on the ele-

ment by the coolant stream. Thermal cycling may introduce plastic axial strains into the cladding depending upon the details of the temperature cycle and the pressure conditions. (auth)

27078 (RWD-RLM-236) KINETIC STUDIES OF HETEROGENEOUS WATER REACTORS. Progress Report No. 24 (Quarterly), July–September 1960. (Ramo-Wooldridge. Div. of Thompson Ramo Wooldridge Inc., Canoga Park, Calif.). Feb. 22, 1961. Contract AT(04-3)-165. 62p. (TID-12842)

Efforts were concentrated on simulated power excursion experiments, and equipment and development, theoretical development of a power-void transfer function model particularly with regard to surface and nucleation effects, and construction and operation of a more versatile boiling loop. (J.R.D.)

27079 (SRIA-36) CONTAINMENT OF FRAGMENTS FROM A RUNAWAY REACTOR. Technical Report No. 4. G. B. Huber and N. R. Zabel (Stanford Research Inst. Poulter Labs., Menlo Park, Calif.). Oct. 31, 1960. Contract AT(04-3)-115. 112p.

The validity was established of a tool for studying various reactor safety problems. This tool is the programmed release in a scaled model of the reactor assembly and housing. Many typical reactor features have already been investigated for their effects on reactor response to runaway. Test results led to the following conclusions: because of the expansion space provided for pressure relief, partially filled reactors (75% water) require more than twice the energy release to obtain the same damage as in a full (100% water) reactor; six initial tests indicate that increasing the strength of the shielding by reinforcing rod can increase the shield's resistance to breakup by more than a factor of 4; introduction of an insulating gap between the model reactor vessel and the shielding markedly reduces the damage to the shielding by attenuating any large-scale pressure pulses; the minimum energy release for damage does not seem to differ appreciably between 100% gaseous products and 20% gaseous products. However, the 100% gaseous energy release is much more damaging when the energy is above this minimum which indicates that the missile hazard becomes much worse as the proportion of gaseous products increases; preliminary tests with steel rods penetrating the model reactor vessel lid into the vicinity of the simulated core have shown that moderately low energy releases are sufficient to propel the rods from the reactor with appreciable energy; and applicability of scaling laws were confirmed with 6 tests of $^1/_{12}$-scale models fabricated and tested with proportionately larger energy sources. A number of tests, with several types of pressure and blast loading that might occur in reactor structures, were conducted to compare the resistance of prestressed and ordinary reinforced concrete. Comparison of the response of pipes of the two kinds, having similar amounts of reinforcing, dimensions, and weight, to sudden internal energy release showed that any superiority of one over the other depended on the rate of energy release. Under severe blast conditions of high explosive tests, such as in a fast reactor runaway, in gaseous fission and radiolytic product reactions, or in "shocking up" of large pressure surges from thermal reactor runaways, both withstand severe shocks or are extensively damaged at similar loads. Pressure pulses generated by a large amount of energy release in water over a much longer duration, such as in a thermal reactor runaway, showed superiority of the prestressed concrete pipe. Penetration tests were carried out with large steel projectiles against 1-in.-thick targets of SA-201 steel. Penetration, for present purposes, is defined as piercing of the shell by fragments, as opposed to splitting, cracking, or tearing. The tests showed that the resistance of the material to penetration is in the same general range as that of other steels tested, but that it does not meet either the predictions of thin target experiments or the performance of some of the other steels. In addition to chemical, metallographic, tensile strength, and hardness tests, standard Charpy impact tests were carried out for each of the five different steels that were used in targets. Results show no apparent correlation with penetration resistance and the brittle behavior observed in penetrations of the steels having lowest resistance. Additional tests were carried out to substantiate information on the damagability of concrete projectiles. The tests indicated that concrete projectiles do not represent a large hazard to a reactor vapor container unless they have a large enough impact face so that during their impingement on the vapor container the crushing strength of the concrete is not exceeded. Calculations of the size required indicated that an impact face of at least 2 feet in diameter is necessary for this condition to be attained, and the necessary velocities estimated from penetration results with steel projectiles require an almost prohibitive amount of energy in the projectile for it to penetrate the vapor container steel. Substantial progress was made in the development of new materials for energy sources to permit the simulation of runaway energy releases having periods much longer than those available from materials presently used. The analytical problem of pressure pulse generation in a fluid by energy release like that in a nuclear runaway was examined in the one-dimensional case. It was found that curves of pressure and compression as functions of initial fluid temperature and of release rate and duration, representing lower limits to a more nearly complete solution can be generated. Ten reactor designs were added to the reactor designs previously surveyed. The geometry of each reactor structure was studied and a description of the materials in the structures was compiled. (auth)

27080 (SRO-53) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, JULY 1961. (Savannah River Operations Office, AEC). 19p.

The design and construction of an on-power refueling machine for CANDU Reactor are described. Experiments being performed in heat transfer loops and on mockup fuel assemblies are outlined. Prevention of hydriding and gas evolution in UO_2 is considered. The performance and fabrication of prototype outer thin-wall fuel tubes are described. The construction progress of the Heavy Water Components Test Reactor is outlined. Research and development of CVTR are described in detail, including pressure tube and fuel development, hazards, components development, and critical experiments. The status of research on the ECNG/FWCNG reactor concept is outlined. (D.L.C.)

27081 (NP-tr-724) EFFICIENCY OF A SYSTEM OF ABSORBING RODS IN A REACTOR WITH A REFLECTOR. V. I. Nosov. Translated from Atomnaya Energ. 9: No. 4, 262-9(1960). 15p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 3629.

27082 ON THE MEASUREMENT OF EXTRAPOLATION LENGTHS IN THE THERMAL COLUMN OF THE L54M REACTOR. S. Corno (AGIP Nucleare, San Donato Milanese, Italy), A. Facchini, V. Sangiust, and M. Terrani. Energia nucleare (Milan), 8: 385-94(June 1961). (In English)

A method is developed to measure the extrapolation

length for thermal neutron absorbers. The method can be applied to absorbers that possess an effectively infinite length, and angular asymmetries around the axis and small non-homogeneities along the axial direction are allowed. The extrapolation length is calculated as an example in the graphite thermal column of the L54M reactor. (auth)

27083 SPURIOUS SIGNALS IN A NUCLEAR REACTOR CONTROL SYSTEM AND TECHNICAL PROCEDURE FOR THEIR ELIMINATION. G. Horn (SORIN, Centro Ricerche Nucleari, Saluggia, Italy). Energia nucleare (Milan), 8: 395-400(June 1961). (In Italian)

Several types of troubles are discussed that appeared during two years of operation of the SORIN swimming-pool reactor, and the procedures followed for their elimination are outlined. The following types of spurious signals are described: radiofrequency interferences; mechanical instabilities in the cables carring low-level signals; voltage fluctuations and fast transients in the ion chamber power supplies; thermoelectric potentials in coaxial cables and connectors placed in strong neutron fields; and ohmic and magnetic inductions. (auth)

27084 SYNTHETIC DESIGN TECHNIQUE IN PLUTONIUM PRODUCTION ESTIMATES. V. Benzi (CNEN, Centro di Calcolo, Bologna). Energia nucleare (Milan), 8: 401-5 (June 1961). (In English)

A technique is developed for the evaluation of plutonium production in thermal reactors. Numerical coefficients are given for a simple but approximate solution of quadratic form depending on neutron temperature, neutron epithermal fraction, flux-time and another variable that take into account the non-leakage probability during slowing-down of neutrons. (auth)

27085 A DIGITAL START-UP CONTROL UNIT FOR NUCLEAR REACTORS. J. D. Schmidt, B. K. Eriksen, and W. Pell (General Electric Co., Syracuse, N. Y.). IRE Trans. Nuclear Sci., NS-8: No. 3, 1-12(July 1961).

The design and development of a unit which computes and displays digitally the reactor level and period over nine decades of power is described. The level of the reactor is obtained from a discriminator and binary counter which resolve 2.5 mv pulses spaced as little as one microsecond apart. A time modulation technique incorporating binary counters for comparison and read-out is used to compute the period with a short term memory employed to provide statistical smoothing. (auth)

27086 PROPORTIONAL CONTROL AND PRESSURIZER PARAMETER STUDY OF A PRESSURE TUBE REACTOR. Donald E. Rathbone (Univ. of Pittsburgh). IRE Trans. Nuclear Sci., NS-8: No. 3, 27-34(July 1961).

An investigation of the transient behavior of a pressure tube reactor indicated a definite need for external control to handle even normal load perturbations. Three proportional controllers were developed which were effective in containing the transients of the system for changes in load. A comparison of the three controllers indicated little preference between them with regard to variations in reactor power, primary loop temperature, or system pressure. The final selection of a controller was thus an economic consideration. The result of the parameter study of the pressurizer indicated that a pressurizer size of 30 cubic feet, 1/9 of the total volume of the primary coolant, was adequate for the containment of the pressure and volume surge transients. (auth)

27087 TOPOLOGY OF LINEAR NEUTRON KINETICS. J. G. Kemeny (Queen Mary Coll., London). Nature, 191: 393-4(July 15, 1961).

In the theory and interpretation of pulsed neutron measurements and in the analysis of random fluctuations in a nuclear fission reactor it is often helpful to study the kinetic behavior of the time-dependent, space-independent model of the multiplying assembly. For this purpose the neutron kinetics may be formulated as an integral equation as opposed to the more conventional set of first-order differential equations. This has some advantages in that the kernel functions of the Volterra-type integral equation have immediate physical significance, the integral equation is logically related to the topological representation of the fission process, numerical computation of resolvent kernels is usually more efficient than forward integration, and extension of the theory to non-stationary reactor kinetics and non-linear reactor topology is obvious. On the basis of a theory presented, the computation of reactor frequency and transient responses is carried out automatically on a digital computer. Step, pulse, ramp, sine, and arbitrary time-responses can be studied for fixed, circulating fuel, and boiling-water reactors. Some solutions of the integral equation are given for linear variations in reactivity. (auth)

27088 ON-LOAD REFUELLING PROBLEMS. K. H. Dent (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Nuclear Power, 6: No. 64, 69-74(Aug. 1961).

The problems involved in continuous refueling with the reactor on-load are studied. The problems discussed in maintaining equal levels of irradiation throughout all the channels in the core are those of refueling capacity, charge and discharge channel arrangement designs, fuel element blow-out and fall-back, fuel element handling equipment design, fuel element temperature control, and remote control operation for fuel element handling. (N.W.R.)

27089 PRESSURE DOOR. (to Chicago Bridge and Iron Co.). British Patent 871,851. July 5, 1961.

A pressure door is described which is particularly suitable for use as an emergency escape lock for a reactor containment vessel. In the event of a nuclear accident or incident within the reactor, personnel can get out of the reactor in a short time, e.g., 15 to 20 sec, and the door is capable of resisting overpressures of 30 to 40 psi. (D.L.C.)

27090 IMPROVEMENTS IN OR RELATING TO REFUELLING MACHINES FOR NUCLEAR REACTORS. Herbert Chilvers Knights (to United Kingdom Atomic Energy Authority). British Patent 873,858. July 26, 1961.

A reactor refueling machine is designed with additional shielding formed of interlocking pads of shielding material. In operation, when the machine is positioned over a charge hole, an electric motor lowers the shielding pads to block the free path of radiations which otherwise would escape between the machine and the charge face of the reactor. (D.L.C.)

27091 NUCLEAR REACTOR WITH COOLING DEVICE FOR FUEL ELEMENTS WHICH ARE TO BE REMOVED THEREFROM. (to Beteiligungs und Patentverwaltungsgesellschaft mit Beschrankter Haftung and Brown, Boveri and Cie, A. G.). British Patent 874,282. Aug. 2, 1961.

A reactor filled randomly with ceramic fuel shapes is designed with means for holding burned-out fuel within the reactor vessel for decay of short-lived activity (radioactive cooling). The means comprises a cooling pan situated below the reactor core with a shielding wall between the pan and core. Two configurations of such a reactor are described, with and without a discharge device. (D.L.C.)

27092 IMPROVED NUCLEAR REACTOR CORE DESIGN. (to U. S. Atomic Energy Commission). British Patent 874,426. Aug. 10, 1961.

An improved reactor core design is proposed for a sodium graphite reactor. The core comprises a plurality of adjoining clad graphite units and fuel elements located in recessed scallops on each side of the units. The fuel elements are disposed in process tubes positioned with clearances in the channels so that the elements and moderator are separately cooled, avoiding thermal fatigue. Moderator cane flexing is minimized by a can head containing a gas absorber and by differential thermal expansion means. (D.L.C.)

27093 IMPROVEMENTS IN OR RELATING TO CARBON-DIOXIDE COOLED NUCLEAR REACTORS. Robert Lind and John Clement Taylor (to United Kingdom Atomic Energy Authority). British Patent 874,487. Aug. 10, 1961.

A method is given for inhibiting the reaction of CO_2 with graphite in reactors. The method consists of maintaining the presence of CO in the CO_2 coolant in the range of 0.5 to 10 vol %, and a reactor with the CO_2 + C reaction inhibited in this way should be equipped for monitoring the coolant and adjusting its CO content. (D.L.C.)

27094 IMPROVEMENTS RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Graham Coates, William Kenneth Bolton, and Frederick Wilde (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 874,739. Aug. 10, 1961.

A fuel element for gas-cooled, solid-moderated reactors is designed for increased heat transfer. The element comprises a hollow cylindrical canned fuel element with fins projecting externally outward and internally inward from the sheathing. The element is supported in a graphite carrier. (D.L.C.)

27095 PROCESS FOR THE TRANSFER OF HEAT BY MEANS OF ORGANIC LIQUIDS. (to Shell Internationale Research Maatschapij N. V.). British Patent 874,860. Aug. 10, 1961.

1,3,5-Triphenyl benzene has properties as a reactor coolant superior to those of terphenyls. It has a m.p. of 174°C and a b.p. of ~460°C, has excellent thermal stability even above 400°C, has a radiation stability at least as good as that of p-terphenyl, and may be used in admixture with terphenyls, etc., to lower its m.p. or with stabilizers. Other advantages are: no induced radioactivity, low vapor pressure at high temperatures, no corrosion, no toxicity, suitable viscosity, and safety in use. (D.L.C.)

27096 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Roger Martin (to Commissariat a l'Energie Atomique). British Patent 874,886. Aug. 10, 1961.

A reactor moderator consisting of graphite blocks is designed with the blocks located by parallel-faced keys in recesses and by struts in horizontal channels between keys in adjacent blocks. Among the advantages of such a design are reduced cooling-gas leaks, greater stability, simplicity, lack of friction between graphite blocks, and ease of machining. (D.L.C.)

27097 IMPROVEMENTS RELATING TO PURGING APPARATUS FOR GAS-FILLED ENCLOSED EQUIPMENT AND PARTICULARLY TO FUEL HANDLING EQUIPMENT FOR GAS COOLED NUCLEAR REACTORS. George Robert Kenneth Jameson (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 875,450. Aug. 23, 1961.

Purging apparatus is designed to avoid contamination of a gaseous reactor coolant by a fuel charging machine. The apparatus comprises means for connection with a gas supply and an exhaust, and cam-controlled valves are used to regulate the purging and pressurizing process. (D.L.C.)

27098 IMPROVEMENT IN NUCLEAR REACTORS. (to Societe Rateau). British Patent 875,462. Aug. 23, 1961.

A reactor fuel element is designed for accurate positioning in a fuel channel in spite of deformation of element and/or channel. The element comprises a stack of cartridges with their contact faces formed with oblique or curved surfaces so that radial forces bear protuberances or projections on the cartridges against the channel wall. (D.L.C.)

27099 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Leslie Mark Wyatt and Malcolm Douglas Jepson (to United Kingdom Atomic Energy Authority). British Patent 875,466. Aug. 23, 1961.

A method for making a sheathed fuel member is described which simplifies manufacture and brings the fuel into close contact with the sheath. The method comprises of forming a sheath on a cylindrical fuel member by extruding sheath material through a die with the fuel member as the mandrel and passing a plug of sheath material through the die behind the fuel member to form an end cap. The die may be shaped so as to produce a finned sheath. (D.L.C.)

27100 IMPROVEMENTS IN AND RELATING TO GAS COOLED GRAPHITE MODERATED NUCLEAR REACTORS. John Edmondson Little (to English Electric Co., Ltd.). British Patent 875,678. Aug. 23, 1961.

A gas-cooled, graphite-moderated reactor is designed for more even temperature distribution in the core. Heat-insulating sleeves are inserted into enlarged bores at the lower part of the fuel channels to form annular heat-insulating spaces between the channels and sleeves. Provision is made for coolant flow in the sleeves in order to prevent axial instabilities due to transient flux peaks. (D.L.C.)

27101 IMPROVEMENTS IN AND RELATING TO GAS COOLED GRAPHITE MODERATED NUCLEAR REACTORS. Derek Moore, David Lawry Booth, John Ludlow Leaper, and Thomas Oliver Jeffries (to English Electric Co.). British Patent 875,679. Aug. 23, 1961.

A gas-cooled, graphite-moderated reactor is designed for a more even temperature distribution in the moderator core. In the reactor, part of the coolant gas is tapped off at a point of a temperature higher than that of the bottom portion of the core and blown therein. (D.L.C.)

27102 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR INSTALLATIONS. Gordon Brown and Norman Thomas Barrett (to United Kingdom Atomic Energy Authority). British Patent 875,813. Aug. 23, 1961.

A nuclear reactor installation is designed with a pear-shaped housing shell, the prolate lower end being supported on a saucer-shaped raft in or on the ground. The advantages of the housing design are that maximum room is available at the charge face level for the refueling machine and heat exchangers, while at the bottom associated buildings may be conveniently located close to the reactor. (D.L.C.)

27103 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Harold Kenyon Hardy and Kenneth John Wootton (to United Kingdom Atomic Energy Authority). British Patent 875,832. Aug. 23, 1961.

A reactor fuel element comprising a sheathed metal fuel member can be improved with respect to heat transfer properties at the sheath-fuel member interface by removing the oxide film on the surface of the fuel member prior to sheathing. For example, after beta quenching and alpha annealing, uranium rods may be machined to remove the oxide films. (D.L.C.)

27104 STRUCTURE OF FUEL ELEMENTS FOR ATOMIC REACTORS. (to Commissariat à l'Énergie Atomique). French Patent of Addition 74,378. Nov. 7, 1960.

The tubular fuel element consists of two cylinders of canning metal which are in contact with each other except at isolated places where exterior bulges are formed in which the fissile material is placed. The cylinders are welded together at their extremities. (NPO)

27105 IMPROVEMENTS RELATING TO THE DETECTION OF BURSTS OF FUEL ELEMENTS IN NUCLEAR REACTORS. (to Commissariat à l'Énergie Atomique). French Patent 1,201,566. Jan. 4, 1960.

For the detection of bursts of fuel elements, the activity is measured of the solid decay products of gaseous fission products, which may be conveyed by a portion of the reactor coolant coming at a given instant from a selected reactor channel. For this purpose the coolant sample is led beforehand through a chamber in which a sufficient portion of the said decay products may be formed and is then led into a precipitation chamber. A part of the wall of the latter chamber is formed by the surface of a collecting drum constituting the negative electrode. A repulsion electrode is placed in front of the surface of the drum. The solid decay products collected on this drum during a precipitation period are then transposed by a rotation of the drum and brought in front of a scintillation counter to measure their activity. (NPO)

27106 IMPROVEMENTS RELATING TO THE DETECTION OF BURSTS OF FUEL ELEMENTS IN NUCLEAR REACTORS. (to Commissariat à l'Énergie Atomique). French Patent 1,201,552. Jan. 4, 1960.

In order to examine the samples of coolant coming from the channels of a nuclear reactor for detecting any burst fuel elements, several channels are grouped in combination with a single detector. In this way the samples coming from the channels of the same group can be examined successively by the said detector. Avoiding the use of expensive electrically operated valves, all the sample lines of each group are in permanent communication with the detector and are provided with an electrostatic precipitation chamber, able to retain the radioactive ions, the activity of which has to be measured. The commutation from channel to channel is effected by successively suppressing the voltage of the precipitation chambers of the various sample lines, during short measuring periods. (NPO)

27107 RADIATION SHIELDING FOR NUCLEAR REACTORS. K. Diebner. French Patent 1,201,873. Jan. 6, 1960.

The shielding space of a nuclear reactor comprises a double-walled casing enclosing the reactor core. The interspace bounded by the two walls of the casing is filled on the one hand with hydrogenated liquid substances and on the other hand, with solid substances that highly absorb nuclear radiation. These solid substances may be constituted by a plurality of absorbing elements, for instance in the form of cylinders or any other appropriate form and may fill the said interspace in a statistical distribution. The said double-walled casing may be fitted with entrance and exit means allowing a circulation of the hydrogenated liquid through the said interspace. The heat created in the liquid is transferred by a heat exchanger. (NPO)

27108 SHOCK DAMPING DEVICE ESPECIALLY FOR CONTROL RODS IN NUCLEAR REACTORS. (to English Electric Co., Ltd.). French Patent 1,201,911. Jan. 6, 1960.

A shock damping device designed to absorb kinetic energy in order to bring a falling body to rest, consists of a tubular piece having a fairly uniform cross section. This tubular piece is provided along a part of its length only, with preformed depressions, so that a large enough axial compressive force acting on the piece, causes a deformation thereof; the piece offers a fairly constant resistance to deformation. During the compression induced by the deceleration forces, triangular or polygonal folds are produced at the places where the depressions are situated. The said piece is deformed beforehand by being submitted to an axial compression, so that at least one fold is formed. Suitably, the wall thickness of the tubular piece may increase progressively along its length and the ends of the piece may be reinforced to resist deformation. (NPO)

27109 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,202,916. Jan. 14, 1960.

A nuclear reactor comprising vertically positioned fuel elements is described. Groups of fuel elements are held and counter balanced against gravitational forces by supports. A means for producing a movement of the supports and thereby a movement of the fuel elements is provided to regulate the reactivity. Preferably the supports are attached to the regulating means by L shaped elements. The electrical control makes it possible to move separate groups of fuel elements or to discharge all the groups at a given time. It is proposed to arrange twelve groups of fuel elements or supports. The fuel elements are spaced on the supports in equilateral triangles. (NPO)

27110 IMPROVEMENTS RELATING TO THE CONTROL OF PARALLEL CHANNELS. (to Compagnie Générale de Télégraphie Sans Fil). French Patent 1,203,109. Jan. 15, 1960.

In order to control parallel channels in which undesirable events may take place, these channels are each in communication with a sampling line in which the fluid composition may be changed by these events. The sampling lines are arranged according to a matrix in which several places are not occupied. The said control is effected by assembling the sampling lines of a selected line of the matrix in the same manner as the sampling lines of a selected column of it, so that scanning takes place from line to line and from column to column. In order to avoid a communication from the matrix line assemblies at a given instant, the lines and the columns under control are always crossed at the said unoccupied places of the matrix. (NPO)

27111 HYDRAULICALLY CONTROLLED VALVE GASKET, PREFERABLY FOR FLUIDS AT HIGH TEMPERATURE CIRCULATING AT HIGH VELOCITY IN THE COOLANT CIRCUITS OF A GAS COOLED REACTOR. (to J. E. H. Waldenmaier Erben Süddeutsche Armaturenfabrik). French Patent 1,203,313. Jan. 18, 1960.

The closure member of a flap valve is fitted with a hydraulically controlled gasket ring, in such a way that this ring supporting a preferably conical gasket may be pressed by an axial movement of the ring against the valve seat. This ring is extended on the inside by an annular rib cooperating with a groove in the body of the closure member. The inner extremity of the rib is connected in a tight manner by a diaphragm with the bottom of the said groove, the ring being connected at its two sides with the upper edges of the groove, so that two chambers are formed between these diaphragms. These chambers may be brought alternately into communication with a pressurized control fluid, so as to produce an axial movement of the ring

through the change in the relative volumes of the said chambers. (NPO)

27112 NEW DEVICE FOR THE DETECTION OF BURSTS OF FUEL ELEMENTS IN HETEROGENEOUS NUCLEAR REACTORS. (to Commissariat à l'Énergie Atomique). French Patent 1,203,722. Jan. 20, 1960.

In order to detect bursts of fuel elements, each channel of a heterogeneous nuclear reactor is provided with a sampling line, conducting the fluid to be examined to detection devices. In order to make a regular check, the sampling lines are automatically and successively switched to the said detection devices, according to a predetermined first program, controlled by a single program unit. If an anomaly is detected, a second control program is started to fix definitely the origin of this anomaly. This second program is also effected automatically and in synchronism with the first program. (NPO)

27113 GRAPHITE MODERATOR ELEMENT. (to General Electric Co.). French Patent 1,203,780. Jan. 21, 1960.

A graphite moderator structure comprising several elements is described in which a channel traverses one or more plane portions adapted to cooperate with the adjacent plane portions of an associated element. These elements constitute a vertical column with the channels in alignment. Several of these plane parts serve to constitute the surface of extending parts of the said elements that maintain each element in position relative to the associated element. (NPO)

27114 NEW FUEL ELEMENT CELL FOR NUCLEAR REACTORS HAVING VERTICAL CHANNELS. (to Commissariat à l'Énergie Atomique). French Patent 1,203,858. Jan. 21, 1960.

A fuel element cell is disposed with its upper end centrally inside the lower end of a vertically arranged tube that has its upper end resting in the upper reactor construction; elastic means interposed between the tube and the cell are able to accommodate longitudinal expansion of the cell. The cell is supported at its lower end in an opening of the lower coolant header. The coolant flows from the said lower header through the cell and leaves it at its upper end by lateral openings. The said upper tube encloses sampling lines or instrument cables. A fluid stream is induced in each sampling line by a diaphragm opening situated inside the cell downstream of the entrance of the sampling line. Bolts projecting radially inwards from the wall of the cell support several fuel elements, each centered by having one end in a hole of the succeeding element. (NPO)

27115 COOLING MEANS FOR CONTROL RODS IN A NUCLEAR REACTOR. (to Commissariat à l'Énergie Atomique). French Patent 1,203,892. Nov. 21, 1960.

In order to guarantee an appropriate cooling of the control rods in a nuclear reactor, these rods are arranged in channels in which the coolant is guided through a diaphragm having a passage variable as a function of the position of the channel in the reactor. The flow section presented by the channels to the coolant is greater the more deeply the control rods reach into the reactor. The channels therefore consist of a series of tubes of successively increasing diameters. (NPO)

27116 CONTROL DEVICE FOR NUCLEAR REACTORS. (to British Thomson-Houston Co., Ltd.). French Patent 1,204,455. Jan. 26, 1960.

In a nuclear reactor having a plurality of control rods, the movement of these rods is controlled by electric motor fed by a low frequency alternating current generator. Switching means are provided to connect the said motors, when required, to the generator. On the one hand the rods may be moved in pairs successively and the movement can be regulated so that a given pair is set in motion when the preceding pair has reached a predetermined stage in its movement, e.g., the end of the traverse or half way, in such a manner that the movement of the succeeding pair begins when the run of the preceding pair is terminated or when its half run is terminated. The rods may also be grouped other than in pairs. On the other hand all the motors may be connected at the same time to the generator voltage. (NPO)

27117 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Hawker Siddeley Nuclear Power Co., Ltd.). French Patent 1,204,689. Jan. 27, 1960.

A nuclear reactor is described with a parallelepiped-shaped core, one of the horizontal dimensions being much longer than the other two dimensions. This is possible for very large reactors where the relation between the volume of the core and its surface is not so decisive in the design calculations of the critical mass as for relatively small reactors. In this way the cores of reactors having different peak powers may be built up by using a plurality of standard core units arranged one beside the other. The longest dimension may be more than twice the other dimensions. The reactor channels traverse the core in a direction crossing the said longest dimension. Preferably the core is surrounded by a steel vessel, the latter being placed within a concrete radiation shielding. The pressure in the interspace bounded by the vessel wall and the inner surface of the shielding may be higher than the atmospheric pressure. (NPO)

27118 NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,205,890. Feb. 5, 1960.

A nuclear reactor is described comprising a tank for the liquid moderator. A number of fuel element units constituted preferably by pipes traverse this moderating tank and include the fissile material, and the reactor coolant composed of liquid metals, circulates in these pipes. The moderator is preferably a deuterium compound at atmospheric pressure. The said pipes are thermally insulated from the moderator liquid. The pipes are connected together at their ends by headers. (NPO)

27119 NEUTRONIC REACTOR. (to American Radiator and Standard Sanitary Corp.). French Patent 1,205,926. Feb. 5, 1960.

In the closed reactor shell, one or more open-ended tubes are suspended by a tube plate which divides the space within the shell into an upper and a lower compartment. These tubes communicate at their upper ends with the upper compartment and at their lower ends with the lower compartment. Fuel elements are supported in the tubes and a liquid mass constituting both coolant and moderator, arranged in and around the tubes, is maintained in boiling heat exchange relation with the fuel elements. Means are provided such that an increase in the degree of boiling brings about an increase in reactivity of the reactor. (NPO)

27120 IMPROVEMENTS RELATING TO GAS COOLED NUCLEAR REACTORS. (to Société Francaise des Constructions Babcock and Wilcox). French Patent 1,206,080. Feb. 8, 1960.

In order to avoid thermal stresses in a reactor pressure vessel, the said vessel is divided into two parts. The first part, constituting the greater proportion of the vessel wall, is fitted with the coolant entrances. The coolant rises from these entrances inside the pressure vessel through the in-

terspace bounded by the inner surface of the said vessel wall and the reactor core and then enters the core at the top. The bottom of the core is in communication with the second part of the vessel, which forms a bottom piece of the vessel wall and is fitted with the coolant exit pipes. This bottom piece is connected with the first part of the vessel by expansion means having preferably the form of part of the surface of a toroid. In this way each of the two parts is held at its own temperature, which is essentially constant in all the elements belonging to the same part of the vessel. (NPO)

27121 AUTOMATIC CONTROL EQUIPMENT FOR A NUCLEAR REACTOR. (to INDATOM (S.A.R.L.)). French Patent 1,206,861. Feb. 12, 1960.

In order to make automatic control equipment for a nuclear reactor that also constitutes an automatic start-up system, the servo-mechanism for the control rods is able to effect a displacement proportional to the control signal. This control signal is derived from the difference between the logarithm of the actual reactor power and a signal emanating from a program unit. The program unit signal is influenced by a signal derived from the difference between the thermodynamic state of the reactor installation and a desired state, and from the differential coefficient of this thermodynamic state with respect to time. The program unit comprises an electric motor driving a logarithmic potentiometer and thus ensures a linear power change. (NPO)

27122 CYLINDRICAL WALL TO CONTROL THE WATER DISCHARGE AND TO CANCEL OUT THE DRIVING FORCE OF THE NATURAL CIRCULATION IN A BOILING WATER REACTOR. (to Commissariat à l'Énergie Atomique). French Patent 1,207,124. Feb. 15, 1960.

To control the water discharge and to cancel out the driving force of the natural circulation in a boiling water reactor that comprises a plurality of cells extended by risers containing steam separators, these cells are surrounded by a perforated cylinder having openings that regulate the water flow from the separators to the reflecting water jacket in such a way that the jacket has a level of water sufficiently low to cancel out the natural circulation of the water. In consequence of this, there is no fluctuation of natural circulation with change in position of the reactor. In addition a thick layer of water inside the cylinder protects the top of the reactor core. (NPO)

27123 IMPROVEMENTS RELATING TO CONTAINERS FOR NUCLEAR REACTORS. (to Société d'Exploitation de Produits Industriels). French Patent 1,207,427. Feb. 16, 1960.

With a view to reducing as far as possible the wall thickness of a nonspherical pressure vessel for a nuclear reactor enclosing an undivided space, the vessel wall is composed of two portions of a sphere, each greater than a hemisphere, connected together at their open edges preferably by welding. The roughly egg-shaped vessel formed in this way is reinforced at the place of the welding by a strengthening ring. Instead of connecting the two spnere portions together directly, other sphere portions, all of the same radius and having two circular openings, may be intercalated and adjacent sphere portions welded together at the edges of the openings; the weldings may be strengthened with rings in the above described manner. In this way a pressure vessel is obtained approximately cylindrical in shape, but having about the same radius of curvature at all points of its surface. (NPO)

27124 TANK FOR A NUCLEAR REACTOR COOLANT. (to W. A. Scholten's Chemische Fabrieken N. V.). French Patent 1,207,525. Feb. 17, 1960.

A tank for the coolant going to and coming from the reactor is arranged above the top of the reactor. This tank is divided into an upper and a lower compartment by a horizontal wall, while the lower one, in its turn, is divided by a vertical wall into an annular and a central part. A pump is provided in the tank to circulate the coolant between the central and the annular part, while a heat exchanger, also mounted in the tank, enables heat exchange of the coolant flowing between the said compartments. Suitably the compartments of the tank are thermally insulated from one another. (NPO)

27125 HANDLING DEVICE FOR FEEDING CAPSULES INTO A NUCLEAR REACTOR FOR IRRADIATION. (to Commissariat à l'Énergie Atomique). French Patent 1,208,604. Feb. 24, 1960.

A handling device is described comprising a brick of graphite provided with cells able to accommodate the capsules to be irradiated. It is introduced into an irradiation channel. A protective plug shields the channel entrance. To charge the capsules into or discharge them from the brick cell or to transfer a capsule into an other cell, the brick is held in a withdrawn position inside a channel in the protective plug. One of the cells is then in alignment with the end of the charging or the discharging chute or with one of the aspiration heads of a transfer box that is able to hold fast and to release the capsules in question. The discharging chute also works by aspiration. Remotely operated cables move rods to push the capsules out of the bricks and in front of the aspiration heads. (NPO)

27126 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,208,777. Feb. 25, 1960.

In a nuclear reactor fuel masses are arranged in a lattice within a moderator, so that the fluid cools these fuel masses internally at places where the thermal neutron flux is a minimum. The fuel masses are protected against the cooling fluid by a sheath material which may have a high neutron cross section and which is compatible with the coolant at the operating temperature. Suitably the fuel masses are constituted by parallelly arranged plates forming a conduit for the cooling fluid. (NPO)

27127 CHARGING CHUTE FOR NUCLEAR REACTORS. (to English Electric Co., Ltd.). French Patent 1,209,278. Mar. 1, 1960.

A charging chute passing through a pipe that gives access to a nuclear reactor is described which enables the charging or discharging of a group of reactor channels with fuel elements. The said access pipe traverses in succession the reactor shell, containing the reactor core and the biological shield, surrounding the reactor shell; it is normally closed by a plurality of plugs arranged axially in line and made of shielding material. The plugs are surrounded inside the access pipe by a further shielding organ constituted by a tube that remains in the access pipe during the introduction of the charging chute and is cooled by fluid circulating through cooling coils. (NPO)

27128 MAINTENANCE DEVICE FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,210,027. Mar. 4, 1960.

In order to enable inspection of the inside of nuclear reactor channels and the performance of maintenance work therein, a maintenance unit that can be introduced into a reactor channel is offered. It is a box in which a television camera, having an elongated form, is mounted. A rotatable tool is also arranged inside this box in front of the camera and means are provided in the box which bypass the camera for controlling the tool mounted in a tool holder. Suitably

the camera is mounted eccentrically in the cylindrical box so as to leave space alongside it for a flexible cable controlling the tools and coupled at its other end with an electric motor arranged behind the camera. (NPO)

27129 IMPROVEMENTS IN NUCLEAR REACTORS. (to Babcock and Wilcox Ltd). French Patent 1,210,082. Mar. 7, 1960.

To avoid oscillations of the fuel element suspended in the core of a reactor installed on a ship that are caused by the rolling or pitching, positioning means are provided to hold the fuel elements, after being brought into their working positions, firmly in these positions. Preferably the positioning means are constituted by lateral radial supports distributed around the fuel element and able to spread out in order to engage with the channel wall. The spreading action is controlled by the force of gravity acting on the fuel element and the reaction force is transmitted to the said lateral supports by the upper end of the succeeding lower fuel element that forms the axial support. (NPO)

27130 IMPROVEMENTS IN THE CONSTRUCTION OF NUCLEAR REACTORS. (to Babcock and Wilcox Ltd.). French Patent 1,210,148. Mar. 7, 1960.

A nuclear reactor is arranged in a closed shell and comprises a moderator structure. Supports between the shell and the said structure act in such a manner that differential thermal expansions or contractions can take place. The support which maintains the lateral position of the moderator structure comprises a wall divided into parts surrounding the moderator structure. The adjacent parts of the wall are connected by compensating means guaranteeing the compression of the wall parts in spite of the thermal expansion of the moderator structure. (NPO)

27131 IMPROVEMENTS TO NUCLEAR REACTORS. (to Babcock and Wilcox Ltd.). French Patent 1,210,149. Mar. 7, 1960.

A device is offered for shutting down a nuclear reactor and to keep it in this state. For instance to shut down a reactor installed on a ship in the event of strong rolling or even capsizing, means are provided to shut down the reactor by insertion of movable control rods and to keep these rods in the shut-down position, even in opposition to the force of gravity. Each control rod may suitably be forced into the reactor by a pressure fluid coacting with a plunger sliding in a cylinder forming the chute for the control rod. When a control rod reaches the shut-down position, a plug connected to it butts against a stop and controls the action of radially working locking means. (NPO)

27132 IMPROVEMENTS RELATING TO NUCLEAR POWER PLANT INSTALLATIONS. (to Babcock and Wilcox Ltd.). French Patent 1,210,168. Mar. 7, 1960.

Safety equipment is described preferably for a nuclear power plant mounted in a ship for propulsion purposes. This equipment comprises valve means able to shut off a part of the cooling circuit of the reactor by isolating this part from the remainder of the system. The closure of the valves is controlled by the state of control circuits that are in close association with at least a part of the outer surface of the part of the system to be shut off, these circuits being mechanically fragile. If one of these circuits is damaged the said valves are closed. Preferably each of these circuits is constituted by fragile tubes that are filled with a gas under pressure and in communication with one side of a piston that normally holds the valve open against the working pressure of the cooling system, so that this working pressure causes the valve to close in the event of any pressure loss in the control circuit. (NPO)

27133 IMPROVEMENTS RELATING TO SUPPORT SYSTEMS FOR BIG CONCAVE VESSELS, ESPECIALLY FOR SPHERICAL VESSELS. P. Saget (to Compagnie Francaise d'Enterprises). French Patent 1,210,341. Mar. 8, 1960.

The support system for a large vessel especially for nuclear reactors consists of a series of stakes, articulated at the one end on sole-pieces and at the other end on spheres let into the wall of the vessel and protruding half inside and half outside the wall. The stakes are inclined at the same angle to the vertical, but alternately in opposite directions. Two adjacent stakes are joined together at the upper ends and carry there a further sole-piece in which one of the said hemispherical outer protuberances of the vessel rests. In the case that a core of a nuclear reactor is mounted within the vessel support pieces are articulated within the vessel at the inner protuberances, each of these support pieces having at its upper end a convex cylindrical surface that rests in correspondingly shaped plates mounted on the base of the support structure of the reactor core. (NPO)

27134 SUPPORT STRUCTURE FOR THE CORE OF NUCLEAR REACTORS. (to General Electric Co., Ltd. and Simon-Carves Ltd.). French Patent 1,210,525. Mar. 9, 1960.

A base structure able to support the core of a nuclear reactor comprising solid moderating material is constructed in such a way that there is unobstructed access to the channels through the base. This base structure comprises a horizontal platform supporting the core and a network of intersecting members forming a grille beneath the platform. A series of columns or compression members are arranged substantially vertically between the said platform and the grille and are attached to the point of intersection of the said intersecting members, so as to transmit the weight of the load to the grille. The shape of the grille is such that the intersecting members are subjected to tensile stresses as opposed to bending stresses under load. Preferably the platform itself is in the form of a shallow grille corresponding to that formed by the said intersecting members. This base structure may be suspended from the inner wall of the pressure vessel by members spaced peripherally around the edge of the platform or may be supported by a peripheral support skirt mounted within the pressure vessel. (NPO)

27135 METHOD AND EQUIPMENT FOR THE CONTROL OF THE COHESION OF A PILE OF BLOCKS ESPECIALLY FOR NUCLEAR REACTORS. (to Société Francaise des Constructions Babcock and Wilcox). French Patent 1,210,733. Mar. 10, 1960.

In a pile of blocks undergoing expansions that vary with time such as the prismatic graphite blocks constituting the moderator structure of a nuclear reactor, the blocks are held together by horizontal belts surrounding the said pile at different levels. The belts are constituted by tubes in which a fluid circulates. The temperature or the flow of this fluid is controlled as a function of the stresses undergone by these tubular belts. Suitably, the fluid also flows through a heat exchanger constituting a part of a closed coolant circuit. The expansion of a part of the tubular belt may control directly throttle means for the said fluid. (NPO)

27136 NEW STRUCTURE OF FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Commissariat à l'Énergie Atomique). French Patent 1,211,572. Oct. 12, 1959.

A number of tubular fuel elements with profiled inner and/or outer surfaces are described. They are manufactured by pressing cylinders of canning metal on a pile of

fuel rings that have the same or different diameters and are spaced from or in contact with each other. (NPO)

27137 NUCLEAR REACTOR WITH ELEMENTS OF FISSILE MATERIAL. (to Sulzer Frères S. A.). French Patent 1,211,585. Oct. 12, 1959.

A number of fuel element assemblies are described consisting of a circle of natural U fuel tubes which are placed in the annulus formed between two cylinders. The inner cylinder contains a tube, rods, or plates of enriched U. The reactor coolant flows down through the interior of the outer fuel tubes and then up through the inner cylinder. (NPO)

27138 RETAINING BAND FOR THE MODERATOR STRUCTURE IN NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,210,802. Mar. 10, 1960.

In order to apply a retaining force to the moderator and reflector structure comprising a plurality of blocks, a retaining band is provided which is a series of links jointed together. These links are in connection with compression shoes that apply the retaining force to the said structure and are rotatable about a pivot mounted in an intermediate element pivotally mounted in its turn on the reactor shell and constituting at the same time a link of the said band. These intermediate elements alternate with ordinary links in the retaining band. Each compression shoe is coupled with its adjacent shoes by tension springs. (NPO)

27139 MODE OF CONNECTION OF A NUCLEAR REACTOR SHELL TO A NUCLEAR PROPULSION UNIT. (to Commissariat à l'Énergie Atomique). French Patent 1,211,601. Mar. 17, 1960.

In order to absorb the differential expansions to transmit the forces through the reactor shell and to roll elastically the reactor core and the shell when this rolling is imposed by the rolling of the unit, the reactor is mounted in the shell by means of radial links. The upper ends of these links are articulated with the reactor core and the lower ends of several links are articulated in the shell, while the lower ends of the remaining links are in an elastic connection with the same shell. The shell is mounted in the unit in the same manner. (NPO)

27140 IMPROVEMENTS RELATING TO MODERATOR AND REFLECTOR STRUCTURES FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,211,878. Mar. 18, 1960.

In order to achieve more stability for the moderator and reflector structure of a nuclear reactor subject to sudden and transient horizontal forces e.g. for a nuclear reactor built in an earthquake region or in a moving body such as a ship, the said structure comprises a series of elastic bands around the structure, each band comprising a series of joined links and each link comprising a nest of coaxial tubes; said bands are radially keyed to a restraint cylinder surrounding the structure. Suitably, these links are joined together by pin joints held by brackets welded to angle section restraint beams which press against the walls of the structure under the tension in the bands. Each of the said beams has an integral key part of rectangular cross section which extends between two bolts screwed in the parallel sides of a further bracket welded on a ring surrounding the said structure, this ring being welded to the restraint cylinder. (NPO)

27141 IMPROVEMENTS RELATING TO FLAP VALVES FOR FLUID CONTROL. (to Thermo-Technical Development Ltd.). French Patent 1,212,086. Mar. 22, 1960.

A flap valve preferably for flow control in the gas ducts of a nuclear reactor installation is described. It comprises a hinged valve closure member controlled by an electric motor, a valve casing, a diaphragm preferably constituted by thin metal sheets, and bridge pieces forming a frame for the valve lid and bolted to the lid so that a free movement of these pieces in the direction perpendicular to the valve seat is secured. The said metal sheets are fixed on the bridge piece so as to extend beyond the edges of these pieces and are pressed on the surfaces of the valve lid on the one hand and of the valve seat in the valve casing on the other hand, thus forming the gas tight closure. (NPO)

27142 IMPROVEMENTS RELATING TO GAS COOLED NUCLEAR REACTORS. (to Société Francaise des Constructions Babcock and Wilcox). French Patent 1,212,099. Mar. 22, 1960.

In order to avoid thermal stresses in the pressure vessel of a gas cooled nuclear reactor, an auxiliary wall is arranged between the pressure vessel wall and the reactor core that is enclosed by it. In the interspace bounded by this auxiliary wall and the inner surface of the pressure vessel wall, cooling gas circulates. Preferably the communication of this auxiliary circulating zone with the main coolant circulation takes place beneath the top of the reactor core. This cooling gas may be delivered, from the coolant ducts feeding the reactor entrances for the main coolant circulation, by a duct provided with throttling means. The said auxiliary circulation in this interspace may be made devious by a set of baffles, imposing a limitation on the flow. In another form of this auxiliary cooling system, the circulation within said interspace takes place between two distribution pipings arranged in the lower and the upper parts of this interspace respectively, this distribution piping being connected outside the pressure vessel via a heat exchanger. (NPO)

27143 STEAMSEPARATOR FOR A BOILING REACTOR CELL. (to Commissariat à l'Énergie Atomique). French Patent 1,213,496. Apr. 1, 1960.

A vertically positioned reactor cell of a boiling water reactor is extended at its upper end by a cylindrical riser terminated by a truncated cone sleeve. The rising water-steam mixture enters the sleeve at the bottom and meets a ring of blades which impose on the mixture a rotating movement. The water leaves the separator by perforations in the sleeve, while steam continues to rise and leaves the separator at the top. (NPO)

27144 ALLOY COMPOSITION FOR CONTROL RODS OF NUCLEAR REACTORS. (to Westinghouse Electric Corp.). French Patent 1,214,215. Apr. 7, 1960.

An alloy composition for control rods of nuclear reactors is composed essentially of (in weight per cent) from 65 to 85% silver, from 2 to 20% indium, from 0 to 10% cadmium, from 0 to 5% tin and from 0 to 1.5% aluminum; the atom fractions X, Y, Z, W, and V of the silver, cadmium, indium, aluminum and tin respectively follow the equation: $X + 2Y + 3Z + 3W + 4V = 1.4$. (NPO)

27145 NUCLEAR REACTOR. (to English Electric Co., Ltd.). French Patent 1,214,596. Apr. 11, 1960.

In order to make the core support of a nuclear reactor resistant to shocks that may be induced by the movements of the ship in which the reactor is mounted or by earthquakes in the case of a land sited reactor, the core support construction, which may rest on a supporting skirt passing through the wall of the pressure vessel and thus supporting also the vessel, is provided on its periphery with radially projecting keys sliding between bearing plates mounted within outwardly radially extending portions of the vessel

wall; each of these latter portions forms on the outside of the vessel a sort of key sliding in its turn between further bearing plates mounted in lateral support organs secured to the inside of the radiation shielding structure. (NPO)

27146 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Hawker Siddeley Nuclear Power Co., Ltd.). French Patent 1,215,447. Apr. 19, 1960.

A safety device for a nuclear reactor comprises a material undergoing a change of physical state at a predetermined critical temperature, so that this material in the physical state existing above this temperature, causes the reactivity and the nuclear chain reaction in the reactor to slow down. Preferably this material is constituted by liquid mercury enclosed in a casing that bursts at the said critical temperature. The mercury then escapes in the form of vapor into interspaces formed between moderator blocks of the reactor and is distributed over a large surface and thus absorbs an important number of neutrons. (NPO)

27147 IMPROVED PRESSURE VESSELS. (to General Electric Co., Ltd. and Simon-Carves Ltd.). French Patent 1,215,455. Apr. 19, 1960.

In order to achieve a minimum of waste space in a nuclear reactor, the pressure vessel enclosing an approximately cylindrical structure of moderating material is of non-spherical, barrel shape, with suitably curved end caps. These end caps may be preferably spherical or ellipsoidal. As the barrel shape is that formed by the rotation of an arc of a circle about an axis, the center of this arc may fall outside the confines of the vessel. (NPO)

27148 NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,216,047. Apr. 21, 1960.

In a gas cooled nuclear reactor, having a closed cooling circuit, a safety valve is provided able to shut down the pressure in this circuit by allowing the coolant to escape into an absorber device. From this valve a first duct leads the coolant to a gas-holder having a bed of stones at its bottom, so that the gas entering the gas-holder is cooled beforehand by these stones in order to reduce its volume. A further duct leads the gas to the absorbing device, the un-absorbed gas returning to the gas-holder. The interspace formed between the reactor vessel and the radiation shield may be purged with clean gas, normally stored in a pressurized state. Preferably several reactor cooling systems are associated with the same absorbing system. (NPO)

27149 IMPROVEMENTS RELATING TO THE DETECTION OF BURSTS IN FUEL ELEMENTS OF LIQUID COOLED NUCLEAR REACTORS. (to Société Grenobloise d'Études and d'Applications Hydrauliques). French Patent 1,216,278. Apr. 25, 1960.

In order to detect gaseous fission products coming from a burst fuel element, a washing gas is injected into the lower part of each reactor cell to strip the said fission products. The washing gas, separated afterwards from the liquid coolant in a degasifier, entrains the fission products that were present in the coolant and conveys them to equipment for measuring their activity. (NPO)

27150 SAFETY EQUIPMENT FOR SHIP REACTORS. (to Foster Wheeler Ltd.). French Patent 1,217,042. Apr. 29, 1960.

A nuclear reactor is mounted in a ship below sea level and is surrounded by a tight metal casing. The reactor with this casing is situated inside a radiation shield so that the inner surface of the shield and the outer surface of the casing form an interspace. This interspace may communicate with the water of the sea by a plurality of normally closed channels, these channels being opened in the case of danger. The said channels are closed by valves which open in the case of loss of the energy actuating these valves. Two valves may be arranged in series in each channel, so that the valve situated near the reactor is a hydraulically actuated valve, while the valve near the exit of the channel into the sea water is an electrically operated valve. The said interspace inside the radiation shield forms with some of the said channels and the sea water outside the ship a natural circulation circuit for any attitude of the ship. (NPO)

27151 PROTECTION DEVICE FOR NUCLEAR REACTORS. W. Cautius. French Patent 1,217,489. May 4, 1960.

A nuclear reactor is enclosed by two concrete protection walls in such a way that one of these walls is enclosed by the other. The interspace bounded by these walls is filled with ammonia having a slightly lower pressure than the atmospheric pressure. In the event of escape of a contaminated fluid into the said interspace the pressure may be controlled by injection of water, so that the pressure in this interspace will never reach atmospheric pressure. This interspace may be put into communication with a decontaminating system collecting all the escaped radioactive wastes. Preferably the inner concrete wall is protected inside and outside by steel casings in such a way that in each case the casing and the adjacent wall surface bound a narrow interspace, which may also communicate with decontamination systems. (NPO)

27152 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to General Electric Co., Ltd.). French Patent 1,217,847. May 5, 1960.

The pressure vessel of a nuclear reactor is suspended from rigid support means by a plurality of suspension members attached to the pressure vessel at points distributed around the vessel and situated below the top of the vessel. These members may be pivotally attached at both ends to the pressure vessel and support means respectively. Preferably the pressure vessel is so shaped that the pressure of fluid within the vessel opposes the bending stress induced in the vessel at the points of attachment of the suspension members. In the latter case the support structure for the reactor core may be suspended from corresponding points on the inner wall of the vessel. The said support structure may also be suspended within the vessel in such a manner as to oppose the stress induced in the vessel at the points of attachment of the suspension members to the vessel. (NPO)

27153 THERMAL SHIELD. (to A. C. F. Industries, Inc.). French Patent 1,218,034. May 6, 1960.

A thermal shield for a nuclear reactor mounted between the reflector elements and the outer concrete shield has the shape of a vertical cylinder open at the top and closed at the bottom, with the exception of a central opening. This thermal shield may be prefabricated and consist of an inner and an outer cylindrical steel casing. In the interspace bounded by these casings cooling coils are arranged, the remaining space being filled with lead by pouring it in molten. The inner surface of the inner casing is coated with a sheet of boral. The said bottom opening and some other lateral openings are also coated with a boral sheet on their lateral cylindrical surfaces. (NPO)

27154 ROTATING TOP SHIELD FOR A NUCLEAR REACTOR. (to A. C. F. Industries, Inc.). French Patent 1,218,113. May 9, 1960.

In a nuclear reactor the fuel elements are arranged in

groups, so that the axes of the elements of the same group lie on the same circle of a plurality of concentric circles, perpendicular to the place of the circles. A rotating radiation shield is mounted above the reactor with its axis of rotation coincident with the axis normal to the said circles. This shield has axial openings disposed along radii at distances from the axis of rotation corresponding to the radii of the said circles, so that by rotation of the shield the axis of each fuel element may be aligned with one of the said openings normally closed by removable plugs. There are locking means for fixing the shield in angular positions corresponding to the said alignments and for preventing any removal of the plugs if the latter are not in alignment with a fuel element, and preventing the rotation of the shield as long as a plug is not in place. During the said locking of the shield in an angular position the control rod drive is automatically put out of action. (NPO)

27155 HANDLING DEVICE FOR THE FUEL ELEMENTS IN A NUCLEAR REACTOR. (to English Electric Co., Ltd.). French Patent 1,218,487. May 11, 1960.

To prevent the subjection of the fuel elements of a nuclear reactor to a thermal shock during their charging into the running reactor, a container capable of enclosing a plurality of fuel elements is provided with heating means to preheat the fuel elements while these are enclosed in this container and before the charge action is started. Preferably these means are constituted by a closed gas circuit incorporating a heater for the gas. The container may also comprise a magazine, which successively brings the elements in line with the charge opening of the container, this opening being in connection with a charge opening in the reactor shell. (NPO)

27156 FUEL ELEMENT FOR NUCLEAR REACTOR. (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). French Patent 1,219,120. Dec. 21, 1959.

A fuel element is described consisting of a fuel rod that is mounted in a supporting frame. To prevent distortion of the rod, it is secured at critical places against displacement by means of braces which are fastened to the vertical columns of the frame. (NPO)

27157 IMPROVED CONTAINER FOR PRESSURIZED FLUIDS. (to A. E. I.-John Thompson Nuclear Energy Co., Ltd.). French Patent 1,219,629. May 18, 1960.

The wall of a container for pressurized fluids is provided with a plurality of bosses, each of these bosses passing through the said wall and having an axial boring. These bosses generally have a cylindrical central portion with conical end portions. The dimensions of these cones and their distance apart depend on the angle at which the boss in question passes through the wall, and are so chosen that the vessel wall is in contact with the two conical surfaces. Each of these surfaces abuts against one of two opposite parts of the elliptical opening (i.e. the parts at the ends of the major axis) in the vessel wall in which this boss is tightly fixed by welding. In the case of the use of the vessel for a nuclear reactor the bosses may constitute extensions of tubes that reach to the reactor charging floor. (NPO)

27158 NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,216,786. Apr. 27, 1960.

To avoid bending moment stresses in a horizontally arranged cylindrical pressure vessel for a nuclear reactor, which stresses would be induced by the weight of the reactor core arranged within the vessel, the supports for the vessel and the supports for the core structure are arranged in radial alignment. The pressure vessel is kept in place on its support structure and the core structure is kept in place within the pressure vessel by supporting means at their top surfaces, viz. by systems of keys and keyways. Preferably the keys and keyways keeping the pressure vessel in place are V-shaped and radial movements of the vessel relative to its support structure may take place. Fixing belts clasping round at least a part of the surface of the vessel are anchored in the supporting structure arranged within the radiation shielding, this shielding being mounted on the main support by keys and keyways. (NPO)

27159 FUEL ELEMENT FOR NUCLEAR REACTORS AND METHOD FOR ITS MANUFACTURE. (to Deutsche Gold- und Silber-Scheideanstalt, Vormals Roessler). French Patent 1,219,876. Dec. 28, 1959.

The diffusion of gaseous fission products from graphite canned fuel elements is retarded by incorporating in the graphite some carbon black or a carbide or nitride of Al, Zr, Ti, Ba or Si. This can be done by impregnating the finished graphite body with a suitable fluid compound and forming the desired substance in situ, or by adding this substance or a suitable compound during the manufacture of the graphite body. The retarders can be homogeneously dispersed or form a separate layer. Use of these fuel elements decreases the contamination of the reactor. (NPO)

27160 IMPROVEMENTS RELATING TO PRESSURIZERS. (to Babcock and Wilcox Co.). French Patent 1,220,310. May 24, 1960.

A pressurizer, preferably for the cooling system of a liquid cooled nuclear reactor, comprises a pressure vessel, means to raise to boiling the liquid inside the lower part of this vessel, means forming a communication for the liquid from the bottom of the vessel to the cooling system to be pressurized, and an injection tube able to spray liquid coming from the said cooling system into the steam space inside the pressurizer vessel and thus to control the working pressure by variation of the quantity of liquid injected. The working pressure is also controlled by the action of the electric heating elements, which are preferably mounted on the bottom of the vessel inside vertical tubes that reach into the boiling liquid and are closed at their upper ends. The exit, forming at the bottom of the vessel a part of the said communication means, is protected by a tubular deflector from the direct influences of the heating elements. (NPO)

27161 ELECTRIC EQUIPMENT FOR THE IMPROVEMENT OF THE HEAT EXCHANGE IN A GAS. (to Commissariat à l'Énergie Atomique). French Patent 1,220,849. May 27, 1960.

In order to improve the heat exchange in a gas, especially the heat transfer from the fuel element to the cooling gas in a nuclear reactor, a preferably alternating field is excited in the space adjoining the heat exchange surfaces. This field moves the ions which have been formed in the gas by any appropriate means, for instance by the said alternating field. Means are provided to reduce the capture and the recombination of the said ions, and prevent the striking of an electric arc. These means may be constituted by a barrier of dielectric material, arranged at appropriate places in the said electric field. (NPO)

27162 CONTROL ROD ABLE TO OFFER RESISTANCE TO INFLUENCES DETRIMENTAL TO NUCLEAR REACTORS AND ITS MODE OF MANUFACTURE. (to U. S. Atomic Energy Commission). French Patent 1,221,442. June 1, 1960.

The mode of manufacture of the control rods consists essentially in sintering billets from finely divided parti-

cles, each particle being individually covered with a layer of metal oxide. The said particles are constituted by an alloy composed essentially of (in weight per cent) from 65 to 85% silver, from 2 to 20% indium, from 0 to 10% cadmium, from 0 to 5% tin and from 0 to 1.5% aluminum; the atom fractions X, Y, Z, W and V of the silver, cadmium, indium, aluminum and tin respectively follow the equation: $X + 2Y + 3Z + 3W + 4V = 1.4$. The particles made from this alloy may be prepared by disintegration of the molten alloy with a jet of cold water. The particles formed in this way are covered with a layer of oxide of the alloy metals. (NPO)

27163 NUCLEAR REACTOR. (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). French Patent 1,221,522. June 2, 1960.

A charge tube for the fuel elements in a nuclear reactor is described comprising a vertical upper section, a lower section that can be displaced radially with respect to the axis of the said upper section, a system to hold the lower section vertical, and an intermediate section joining the upper and the lower sections. The radial position of this lower section is suitably controlled by a ring sliding along the said intermediate section of the charge tube and an adjustable lever connects this ring with a central organ controlling the position of this ring and consequently the radial position of the intermediate and the lower sections. (NPO)

27164 ELEMENTS FOR ATOMIC PILES. (to United Kingdom Atomic Energy Authority). French Patent 1,222,623. Jan. 25, 1960.

The fuel element consists of a pile of ceramic fuel rings in a closed tubular container, the interior cavity being filled with sintered MgO or MgO foam. Each container is provided at each extremity with a perforated lip, so that a train of fuel elements can be assembled by pinning them in horizontal and vertical succession to a number of cross-members. The assemblies are suspended in the core channels. (NPO)

27165 IMPROVEMENT RELATING TO METHODS OF NUCLEAR RADIATION SHIELDING. (to Commissariat à l'Énergie Atomique). French Patent 1,222,649. June 10, 1960.

A radiation shielding construction is described in which the radiation absorbing materials have a shape such that the heat developed by the absorption tends to become distributed in the depth. Preferably this is secured by arranging surfaces, sheets or slits in the construction in a direction oblique to the direction of radiation. This heat may be removed as it is developed by a cooling fluid circulating through the shielding construction. (NPO)

27166 IMPROVEMENTS TO REFLECTORS IN NUCLEAR REACTORS. (to A. G. für Unternehmungen der Eisen- und Stahlindustrie and Brown, Boveri and Cie A. G.). French Patent 1,222,910. June 14, 1960.

In order to improve the efficiency of reflectors in nuclear reactors, means are provided to increase the reflector temperature above the level normally reached in consequence of the thermal gradient between the core and the reactor shell, for instance by heating the reflectors or thermally insulating them. To this end the reflector may be fitted with tubes through which hot liquid circulates, heated beforehand in the reactor core, or it may be surrounded by thermal insulation. (NPO)

27167 A PROCESS TO NORMALIZE RAPIDLY THE ATMOSPHERIC CONDITIONS IN THE PROTECTION HALL OF A NUCLEAR REACTOR AFTER THE RISE OF TEMPERATURE AND PRESSURE CAUSED BY A REACTOR ACCIDENT. (to Aktiebolaget Svenska Fläktfabriken). French Patent 1,223,100. June 15, 1960.

In order to normalize rapidly the atmospheric conditions in the protection hall of a nuclear reactor after the rise of temperature and pressure inside this hall caused by a reactor accident, a heat exchange system is mounted preferably in the upper part of the hall to cool the hall atmosphere after it has become heated, for instance by an escape of steam into the hall in consequence of the reactor accident. The heat exchange system may be fed with liquid ammonia, CO_2 or any other coolant under pressure. The absorption of heat results in evaporation or expansion of the coolant, which then escapes freely into the atmosphere. Suitably, the introduction of the coolant into the heat exchange system is started automatically in the case of danger. (NPO)

27168 IMPROVEMENTS IN SUPPORT DEVICES FOR NUCLEAR REACTOR FUEL ELEMENTS. (General Electric Co., Ltd.). French Patent 1,223,823. Feb. 1, 1960.

A fuel element is supported in a vertical core channel by means of a telescopic cross-beam, the ends of which can clutch in two diametral notches in the channel wall. The telescopic elements can be secured against mutual displacement by means of a frictional locking device or by means of a pin which is fixed on the bottom cap of the fuel element. (NPO)

27169 EQUIPMENT FOR KEEPING THE CORE OF A NUCLEAR REACTOR, UNDERGOING THERMAL EXPANSIONS, IN THE RIGHT POSITION. (to Hawker Siddeley Nuclear Power Co., Ltd.). French Patent 1,223,927. June 21, 1960.

In order to keep the core of a nuclear reactor undergoing thermal expansions in a predetermined position with respect to the pressure vessel enclosing this core, a thrust ring at the top of the core and generally frusto-conical in shape urges the core against the base. Preferably, the said base is made from a steel framework designed to bear the dead load of the core and supports a further frusto-conical thrust ring, so that the two thrust rings hold the core between them. These rings may be provided with organs having radial keyways in which keys, mounted on the inner wall of the pressure vessel, can slide. Each thrust ring is urged in the appropriate direction by spring loads transmitted to each thrust ring by bellcrank levers from springs located outside the main wall of the pressure vessel. (NPO)

27170 NUCLEAR FUEL. (to United Kingdom Atomic Energy Authority). French Patent 1,225,443. Feb. 15, 1960.

Vitreous reactor fuels are described which consist of UO_2 (I), Al_2O_3 (II), SiO_2 (III), MgO (IV) and CaO (V). Preferred compositions are (in wt.%) I: 30.9 (38.2), II: 60 (53.75), III: 7.1 (6.3), IV: 1.3 (1.17), V: 0.7 (0.58). (NPO)

27171 MAINTENANCE DEVICE FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,225,987. July 6, 1960.

Television equipment for remote viewing of the inner structure of a nuclear reactor is offered. This equipment includes a television camera movably mounted on an arm, which is in its turn movably mounted on a support and this equipment enables the introduction of the said camera, with the arm and the support, into a hole that gives access to the inner reactor structure and enables the turning of the support on its own axis and the control of its vertical position. After introduction the support is laterally displaceable by the equipment to point the camera in different directions. (NPO)

27172 CONTROL DEVICE FOR NUCLEAR REACTORS. (to U. S. Atomic Energy Commission). French Patent 1,226,062. July 8, 1960.

A nuclear reactor is described which consists of a plurality of vertical fuel units, each constituted by a long cylindrical container open at its top, in which the fuel in a liquid form is placed. A movable plunger dips in this liquid so as to form an annular space in which the liquid may be displaced by the action of the said plunger in order to change the position of the liquid level. The annular spaces of the fuel units are situated at least partly in the reactor core. The plungers may be joined together and moved by the same equipment in order to control the reactivity of the reactor by forcing part of the liquid fuel out of the reactor core or by allowing it to pass back into the core. (NPO)

27173 GAS COOLED NUCLEAR REACTOR. (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). French Patent 1,227,778. Aug. 24, 1960.

For a gas cooled nuclear reactor equipment is provided for conveying the fuel elements from a container situated outside the reactor vessel into the reactor channels. This equipment comprises a chute extending from the wall of the reactor pressure vessel, and a flexible tubular conduit extending from the lower end of the said chute and reaching into the space inside the vessel above the reactor core. The lower end of the tubular conduit can be tightly joined with the end of a selected reactor channel. The gas flow in the conduit is controlled and may pass into the reactor vessel by an opening near the upper end of the conduit. Suitably, the conduit is formed by several tubular sections joined together by bellows. (NPO)

27174 NUCLEAR FUEL. (to United Kingdom Atomic Energy Authority). French Patent 1,228,590. Mar. 14, 1960.

UO_2 compacts are prepared by compacting non-stoichiometric uranium dioxide having an O:U ratio between 2.06:1 and 2.25:1, sintering these compacts in an inert atm at 1100 to 1500°C and finally heating in a H_2 atm at 1200°C at least. (NPO)

27175 ACTIVE SLUGS FOR NUCLEAR REACTORS. (to C. A. Parsons and Co., Ltd.). French Patent 1,229,523. Mar. 21, 1960.

Sheathed fuel elements are described. The can is subject to a greater thermal expansion than the slugs. To avoid this the contact between the can and the slugs is broken, and the slugs are provided with peripheral, e.g. longitudinal, grooves or surface notches which can take up the expansion of the can when the latter is under coolant pressure. (NPO)

27176 NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,229,841. Sept. 9, 1960.

In a boiling water reactor having a negative void coefficient of reactivity, the reactor control is effected by directly varying the void volume of the moderator. Preferably the desired value of the latter is realized by variation of the quantity of a control moderator fluid contained in a multitude of tubes arranged throughout the reactor space in a regular lattice. These tubes may be supported in the same manner as the fuel elements between an upper and a lower grille. The void volume may be varied by feeding the tubes from a control moderator storage basin through pipes that are in communication with the lower ends of the tubes via a reversible pump. The tubes may also be drained quickly into the said basin through a drain pipe short-circuiting the pump. (NPO)

27177 NUCLEAR FUEL ELEMENT, CONTAINING A BODY OF FUEL THAT IS PERMEABLE TO THE REACTOR COOLANT. (to Siemens-Schuckertwerke A. G.). French Patent 1,229,978. Mar. 28, 1960.

The fuel element consists of a tubular container with perforated walls, which is filled with Zr-coated fuel grains or spheres. The size of the perforations and/or the grain size can vary along the length of the element, e.g. smaller perforations at its extremities, in order to adapt the circulation of the coolant to local reactor conditions. (NPO)

27178 CONTROL ROD FOR NUCLEAR REACTORS. (to General Electric Co., Ltd.). French Patent 1,230,177. Sept. 14, 1960.

Each control rod for a nuclear reactor is normally suspended by an electro-magnetically controlled gripper device, which is arranged to release it in order to effect reactor shut down. The rod comprises an upper head portion connected to a lower flexible active portion, the latter constituted by a series of links of a chain, each link being provided with neutron absorbing means; a link may suitably be formed by two semi-cylindrical parts held together by a surrounding stainless steel cylinder. The lower end of the flexible portion may be provided with a conical massive end piece. Preferably the head portion comprises a shock damping device that absorbs the kinetic energy to bring the falling rod to rest in the case of a reactor shut-down. This damping device contains two coaxial springs that are in mutual frictional contact. (NPO)

27179 NEUTRON ABSORBING ELEMENTS FOR THE CONSTRUCTION OF REACTORS AND METHOD FOR THEIR MANUFACTURE. (to Gebr. Böhler and Co., A. G.). French Patent 1,230,962. Apr. 4, 1960.

Control rods and shielding elements are described which consist of a core of sintered Fe or a non-alloyed steel containing 2 to 15% of a neutron-absorbing compound (e.g. commercial Sm_2O_3), the core having a specific gravity of at least 7.0 g/cm^3 and being enveloped by a corrosion-resistant jacket. Preferably the sintering of the core material is performed in situ in a jacket which consists of an inner layer of iron or non-alloyed steel and an outer layer of stainless steel. (NPO)

27180 CARBON DIOXIDE COOLED NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,230,979. Apr. 4, 1960.

To prevent the reaction between CO_2 and C, 0.5 to 10 vol.% CO is added to the CO_2 coolant of graphite moderated reactors. (NPO)

27181 EQUIPMENT CONTROLLING THE TEMPERATURE IN A NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,231,292. Sept. 28, 1960.

In a graphite moderated nuclear reactor means are provided for dividing the coolant stream traversing the reactor into a fraction cooling the fuel elements and a fraction cooling the graphite moderator. These means regulate the relative quantities by increasing the moderator coolant fraction if the temperature of the fuel coolant fraction increases. A temperature responsive device controls a valve disposed in an opening forming a communication between the space constituting the path for the moderator coolant fraction and the space forming the path for the fuel element coolant fraction. Suitably, the temperature responsive device is constituted by an element actuating the valve by thermal expansion and responsive to the temperature difference of the coolant fractions. (NPO)

27182 NUCLEAR REACTOR WITH EQUIPMENT FOR QUICK SHUT-DOWN. (to U. S. Atomic Energy Commission). French Patent 1,231,554. Sept. 30, 1960.

A neutron-absorbing control rod able to move in the di-

rection of its axis and intended to be propelled into the reactor to produce the shut-down, is connected at the end remaining outside the reactor with a piston acting in a cylinder. Suitably the control rod enters in a vertical direction from beneath the reactor, and the piston rests without any fastening on a plate perpendicularly disposed with respect to the axis of the rod and is moved by mechanical means in the direction of the axis of the rod and thus controls the reactor. The side of the piston opposite the control rod is in communication with a first quantity of fluid under pressure, while the other side of the piston is in communication with a second quantity of fluid under pressure. For propelling the rod rapidly into the reactor, the pressure of the second quantity of fluid is released. (NPO)

27183 SCRAM EQUIPMENT FOR A NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,233,206. Oct. 12, 1960.

The scram equipment comprises a multiplicity of neutron absorbing balls normally accommodated in an annular storage container surrounding the top end of a vertical reactor channel, means to release the said balls, in the case of danger, by cutting the magnetic retaining forces and thus to charge the balls into the channel through lateral openings therein. The balls are received by a tubular container located at the bottom of the channel and enabling their recovery. The container is closed at its bottom by a releasable cover and will remain closed as long as the container remains in the channel, as a result of the constraining action of the channel walls on the cover. When the container is pulled up out of the channel, its cover will tilt down and the balls will be released and recharged into the annular storage container. (NPO)

27184 FUEL ROD WITH INTERIOR CHANNELS FOR NUCLEAR REACTOR. A. Huet. French Patent 1,234,258. May 16, 1960.

Cylindrical or conical fuel rods are described. They are provided with an axial channel and with straight or curved transverse channels between the inner and outer surface. The number of these transverse channels per unit of length as well as their direction can vary along the length of the rod. These fuel rods find application in boiling liquid reactors in which they moreover serve as liquid-vapor separators and vapor superheaters. (NPO)

27185 FUEL ELEMENT FOR ATOMIC REACTORS AND METHOD FOR ITS MANUFACTURE. (to Deutsche Gold- und Silber-Scheideanstalt, Vormals Roessler). French Patent 1,234,524. May 16, 1960.

A fuel element for high-temperature applications in a gas cooled reactor is described. It consists of a core of U or Pu carbide, sheathed with Zr or Si carbide. It can be manufactured by pouring either the pulverized fissile carbide or a pulverized mixture of fissile metal or its oxide and graphite into the finished carbide sheath and sintering, or by compacting pulverized core and sheath material, followed by sintering. (NPO)

27186 IMPROVEMENTS RELATING TO PRESSURE CONTAINERS OF NUCLEAR POWER PLANTS. (to Babcock and Wilcox Co.). French Patent 1,235,104. May 23, 1960.

The primary cooling system of a nuclear power plant is described. It comprises in series the components that constitute a closed circuit of the reactor coolant. It is enclosed by a pressure container that has a narrow protection space between its inner wall and the outside of the said components, over their whole length. This protection space may be divided by tight walls into several compartments. Inside each compartment a control fluid circulates in which any escape of the reactor coolant may be detected. (NPO)

27187 IMPROVEMENTS IN SLUGS OF FISSILE MATERIAL FOR NUCLEAR REACTORS. (to Commissariat à l'Énergie Atomique). French Patent 1,235,429. May 30, 1960.

The method describes a device for varying the mutual distance of the members of a small group, e.g. 3, of fuel rods while maintaining their symmetrical arrangement. The device comprises two rotatable plates provided with a number of non-radial, rotation-symmetrically disposed straight grooves, in which grooves the fuel rods are slidably supported. (NPO)

27188 FUEL FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,237,086. June 13, 1960.

A nuclear fuel for high-temperature application is described. It consists of a fritted mixture of a fissile material (e.g. 20 wt.% UO_2 or PuO_2) and a creep-resistant ferritic steel, e.g. a ferritic steel containing 0.08 to 0.15% C, 0.4 to 0.7% Mn, 0.9 to 1.1% Mo, 2.0 to 2.4% Cr and 0.1 to 0.3% Si. (NPO)

27189 IMPROVEMENT IN NUCLEAR REACTORS. (to Babcock and Wilcox Ltd.). French Patent 1,237,440. June 20, 1960.

A helically finned fuel rod is described which is provided with helical splitters that are wound in the opposite direction. According to a modified construction the splitters are only helical at the extremities of the fuel element and run axially at its center part. (NPO)

27190 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Société Générale de Constructions Électriques et Mécaniques (ALSTHOM)). French Patent 1,238,378. July 4, 1960.

Tubular fuel elements are described in which ceramic fuel in the shape of spaced ring segments is disposed around the interior tube wall. The space between these segments and the exterior wall is filled with a heat insulating material, e.g. MgO, or left empty. The exterior wall is provided with internal fins to support the segments; alternatively the segments can be provided with projections which contact said wall. The reactor coolant or steam to be superheated flows through the tube which is surrounded on the outside by the moderator. (NPO)

27191 METHOD FOR MANUFACTURING A FUEL ELEMENT FOR NUCLEAR REACTORS. (to U. S. Atomic Energy Commission). French Patent 1,238,751. July 11, 1960.

A rotary swaging process is given for the manufacture of ceramic fuel elements. The ceramic fuel consists of UO_2 powder having a particle size of 0.31 to 0.07 mm, to which 1 wt.% U can be added. The container is formed of a Zr alloy, containing 1.5% Sn, 0.12% Fe, 0.10% Cr and 0.05% Ni. Alternatively an Al container can be used. The swaging is then effected in a steel sleeve. One of the end caps of the container is provided with a small opening so that occluded gases can escape during the first stages of the swaging process; this opening is welded up before the final stage. (NPO)

27192 IMPROVEMENTS IN NUCLEAR REACTORS. (to Babcock and Wilcox Co.). French Patent 1,242,102. Aug. 16, 1960.

Improvements consisting of the application of fuel elements in which 200 to 1000 ppm of a burnable poison (enriched B or Eu) are homogeneously dispersed in the stainless steel can are offered. (NPO)

27193 IMPROVEMENTS IN NUCLEAR REACTORS. (to Rolls-Royce Ltd.). French Patent 1,242,170. Aug. 16, 1960.

A metal strip is shaped into a tube, the adjacent edges being bent outwards to form an upstanding brim. This tube is twisted about its axis and the brim welded. Thus a fuel element can with a single helical rib is obtained. The can is filled with fuel pellets and capped. Nineteen of these fuel rods and two supporting grids form the fuel element assembly. (NPO)

27194 JOINT FOR ATOMIC PILE. (to Sylvania Corning Nuclear Corp.). French Patent 1,242,423. Aug. 22, 1960.

Fuel elements consisting of a number of parallel flat or curved, rectangular, canned fuel plates are described. They are held together by two parallel lateral supporting plates. The ends of the fuel plates are inserted in grooves in the supporting plates, after which a wedging wire is forced into the groove. (NPO)

27195 FUEL FOR HOMOGENEOUS NUCLEAR REACTORS. (to Allmänna Svenska Elektriska Aktiebolaget). French Patent 1,244,546. Sept. 19, 1960.

The addition of Be, Mg or Al salts to homogeneous reactor fuels consisting of a moderator liquid (e.g. water), a dissolved fuel (e.g. UO_2 SO_4), a dispersed fertile material (e.g. ThO_2) and, optionally, a recombination catalyst, is described. This addition prevents the adsorption of fuel and catalyst by the fertile particles. (NPO)

27196 SLURRIES TO BE UTILIZED AS FERTILE MATERIAL IN NUCLEAR REACTORS. (to General Electric Co., Ltd.). French Patent 1,245,181. Sept. 26, 1960.

A new fertile material is described consisting of a slurry β-$ThSi_2$ in liquid Bi or Bi alloy. The β-$ThSi_2$ is prepared by heating a mixture of Th and Si containing 66.7% Si in an inert atm above 1400°C. This gives α-$ThSi_2$. Heating this modification at 700 to 1050°C, e.g. 4 hr at 850°C, transforms it into the β phase. The slurry can be directly prepared by heating the matrix metal and the above-mentioned mixture of Th and Si during 40 hr at 750°C. (NPO)

27197 THORIUM OXIDE SLURRY, TO BE UTILIZED AS A FERTILE MATERIAL IN NUCLEAR REACTORS. (to General Electric Co., Ltd.). French Patent 1,245,345. Sept. 26, 1960.

A slurry of ThO_2 in molten Bi or Bi alloy is obtained by dissolving metallic Th in the matrix metal and adding Bi_2O_3. Preferably the reduction is performed at 500°C and 10^{-5} mm Hg. (NPO)

27198 FUEL ELEMENT FOR NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,245,848. Oct. 3, 1960.

A tubular fuel element, primarily intended for application in organic moderated reactors, is described. It comprises an annular container which holds several (e.g. 2) coaxial, annular, canned fuel plates between its walls. The cans are provided on both sides with helical fins. The fins of adjacent surfaces are wound in opposite directions and contact each other. Coolant passages are thus created between the fuel plates, while the central channel serves for the passage of a liquid moderator or for the insertion of a moderator or control rod. (NPO)

Power Reactors

27199 (ACNP-6113) PATHFINDER ATOMIC POWER PLANT RADIOGRAPHIC PROOF-TESTING OF PROPOSED REACTOR-VESSEL NOZZLE AND ATTACHMENT-WELD DESIGNS. J. F. Patterson, H. B. Norris, and J. F. Potochnik (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). June 9, 1961. Contract AT(11-1)-589. For Northern States Power Co. and Central Utilities Atomic Power Associates. 24p.

Radiographic inspections were conducted on full-scale models of three reactor vessel nozzle designs with simulated defects in the attachment welds and nozzle walls. The tests revealed all defects in the recirculation inlet nozzle model and most but not all of the defects in the control-rod-drive nozzle model, while multiple exposures at different angles revealed all the defects in the instrumentation nozzle model. (D.L.C.)

27200 (ACNP-6114) PROTOTYPE RECIRCULATION PUMP TESTS. PATHFINDER ATOMIC POWER PLANT SUMMARY REPORT. Richard Haugen and D. J. Nolan (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). July 17, 1961. Contract AT(11-1)-589. For Northern States Power Co. and Central Utilities Atomic Power Associates. 64p.

Results of tests performed on the Pathfinder Atomic Power Plant recirculation prototype pump and its components are presented. Tests included a preliminary seal test, a serrated bushing test, a cold performance test, and a hot loop test. Results indicated that the pump should give trouble-free service in the field if operated as intended and within the limits specified. An analysis was made of the prototype trunnion supports for the Pathfinder recirculation pump. (M.C.G.)

27201 (AD-252281) SM-1 EMBRITTLEMENT PROBLEM, MODIFICATION AND TESTING. Period covered, September 8, 1960 through November 8, 1960. G. W. Knighton (Corps of Engineers. Nuclear Power Field Office, Fort Belvoir, Va.). Nov. 30, 1960. 108p. (OSB-11)

The shut down of SM-1 due to information concerning the effect of neutron damage in the A212B carbon steel reactor vessel is discussed. The evaluation of the problem as well as the corrective action and test required to resume operations are presented. (auth)

27202 (APAE-Memo-286) FLUX AND POWER DISTRIBUTIONS FOR THE SM-2 REFERENCE AND CRITICAL EXPERIMENT CORES. B. E. Fried, M. R. Alford, and J. P. Oggerino (Alco Products, Inc., Schenectady, N. Y.). June 30, 1961. Contract AT(30-3)-326. 113p.

A detailed analysis was made of the power distributions in the SM-2 experimental core at 68°F and the SM-2 reference core at 510°F. This analysis supersedes the power distribution calculations presented in APAE No. 69. The calculated distributions for the experimental core were normalized to measured data wherever possible in order to obtain corrections factors for application to the reference core. The over-all power distributions were calculated by synthesis of one-dimensional axial calculations with two-dimensional radial calculations. The variation of the power distribution with fuel burnup is also presented. In order to improve the agreement between measured and calculated axial power distributions, flux-weighting the nuclear parameters in the rods-in and rods-out regions was investigated. (auth)

27203 (APAE-Memo-288) DYNAMIC SIMULATION OF MULTI-PASS PRESSURIZED WATER NUCLEAR POWER PLANTS BY ANALOG COMPUTER TECHNIQUES. J. O. Brondel (Alco Products, Inc., Schenectady, N. Y.). June 1961. 132p.

Thesis submitted to Union Coll., Schenectady, N. Y.

A kinetic model of the primary loop of a multi-pass pressurized water reactor power plant is developed to evaluate,

by analog computer techniques, the transient response characteristics under conditions of steam generator load and reactor control rod perturbations. Using the 2-pass 28 Mw(t) SM-2 reactor as a typical plant, transient behavior patterns are illustrated and examined for a variety of load inputs, variations in plant constants, and analog model simplifications. (auth)

27204 (CF-61-6-12) THE EFFECT OF SIZE ON THE INVESTMENT IN THE REACTOR PROPER OF AXIAL UPFLOW PEBBLE BED REACTORS. R. B. Korsmeyer (Oak Ridge National Lab., Tenn.). June 5, 1961. 20p.

The axial upflow pebble bed reactor has an inherent economic handicap that becomes prominent as the reactor power is increased. The handicap arises from the combination of decreasing gas pressure with increasing pressure vessel size, decreasing allowable power density in the fuel with increasing fuel ball diameter, and increasing ball diameter with decreasing gas pressure to avoid bed levitation. The resultant effect is that the core power density is reduced as the reactor power is increased, and thus much of the reduction in unit cost of investment otherwise realized with increasing reactor power is offset. There appears to be a reactor size beyond which unit costs increase with size, although it is probably larger than 500 Mw(e) for reactor power stations approaching the efficiency of modern steam plants. The economic incentive to develop a practicable bed restraint for the upflow core or a reliable support for the downflow core therefore increases with reactor size. (auth)

27205 (DLCS-2250101) REACTIVITY LIFETIME. TEST RESULTS DL-S-225(T-612118). Section I, First Performance. (Duquesne Light Co., Shippingport, Penna.). First issue, Oct. 24, 1958. 143p.

The performance, reliability, and reactivity lifetime of the Shippingport PWR are determined under normal steady state conditions. These characteristics are studied over a period of 1011 EFPH, at a power level of about 60 Mw(e). Flux tilts that occurred during this time, as well as the means employed for their suppression, are described. (T.F.H.)

27206 (DLCS-2250102) REACTIVITY LIFETIME. TEST RESULTS DL-S-225(T-612118A). Section I, Second Performance. (Duquesne Light Co. Shippingport, Penna.). First issue, Mar. 4, 1959. 171p.

The performance, reliability, stability, and reactivity lifetime variations of the Shippingport PWR are determined under normal steady state conditions. These characteristics are studied over a period of 758 EFPH, at a power level of about 60 Mw(e). Flux-tilt corrections and plant operations during this time are described. (T.F.H.)

27207 (DP-635) HEAVY WATER MODERATED POWER REACTORS, PROGRESS REPORT, JUNE 1961. L. Isakoff, comp. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Aug. 1961. Contract AT(07-2)-1. 44p.

The reactor vessel for the Heavy Water Components Test Reactor was received at the plant site. Construction of the HWCTR was 75% complete by the end of June. Satisfactory preliminary results in the coextrusion of three Zircaloy-clad thin-walled tubes of uranium metal indicated that the process is satisfactory for the fabrication of identical HWCTR test elements. Precision buckling measurements were made on 31-element clusters of 0.5-inch-diameter pelletized UO_2 rods in D_2O. Pressure drop data on the flow of boiling water at 1000 psia through seven-rod simulated fuel clusters were obtained. (auth)

27208 (GEAP-3609) HIGH POWER DENSITY DEVELOPMENT PROJECT. DESIGN AND FABRICATION OF HIGH POWER DENSITY FUEL ASSEMBLIES FOR VBWR IRRADIATION TESTING. W. D. Fowler and J. W. Lingafelter (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Nov. 1, 1960. Contract AT(04-3)-361. 76p.

Design criteria and calculations are presented that formed the basis for the design of 24 fuel assemblies for high power density operation in VBWR. The assemblies consisted of four 16-rod fuel follower assemblies and twenty 25-rod test assemblies. Two UO_2 sintered pellet sizes, 0.330-inch diameter and 0.375-inch diameter, were selected for evaluation. Twelve 25-rod fuel assemblies were made using the 0.330-inch diameter pellets with 0.014-inch thick 304 stainless cladding. The remaining eight 25-rod assemblies used the 0.375-inch pellet size, with four assemblies using 0.017-inch thick 304 stainless steel tubing; and the remaining four 0.012-inch tubing. The four 16-rod fuel follower assemblies used 0.375-inch pellet size and 0.020-inch thick stainless cladding. The fuel manufacturing process used to fabricate the 24 assemblies was the current oxide fuel fabrication process. Uranium oxide powder was converted by pressing and sintering into dense, sintered fuel pellets. The pellets were loaded into 304 stainless steel tubes, and the ends of the tube welded to end plugs to produce a fuel rod. Fuel rods were mechanically assembled into a fuel assembly consisting of either 25 rods or 16 rods. Detailed fuel rod and fuel assembly information were recorded. (auth)

27209 (GNEC-144) ZERO-FLOW SHUTDOWN COOLING TEST FOR BONUS-TYPE SUPERHEATER ELEMENTS, Terminal Report on HEAT-TRANSFER TESTS SIMULATING LOSS OF COOLANT. (General Nuclear Engineering Corp., Dunedin, Fla.). Nov. 21, 1960. 70p. Contract AT(11-1)-795.

Experiments are conducted to determine the steady state heat dissipation properties of the BONUS superheater fuel elements with reactor shutdown and zero steam flow. Three cases are considered: steam flow stoppage coincident with, 1 min after, and 2 min after reactor shutdown. The maximum temperatures reached in the core are calculated as functions of the heat generated and of the fuel element surface condition and in-pile time. (T.F.H.)

27210 (GNEC-159) NUCLEAR SUPERHEAT DEVELOPMENT PROGRAM. Sixth Quarterly Progress Report, October-December, 1960. (Combustion Engineering, Inc., Windsor, Conn. and General Nuclear Engineering Corp., Dunedin, Fla.). Contract AT(11-1)-795. 86p.

The semi-mockup series (intermediate geometry) of critical experiments with rod-type superheater fuel was completed. The double-annular fuel elements for NuSu critical experiments were fabricated by vibratory compaction; nearly 100% yield was obtained from the fused UO_2. Results of NuSu critical experiments correlation with theoretical calculations are included. In experiments with a tube which simulates the NuSu reactor superheater element, 30 to 80% of the P^{32} tracer was deposited on the tube. A preliminary corrosion rate obtained in this test, done with stainless steel tubing, is 1.3 mils/year. The rate is expected to increase with temperature. Further experimentation on this phase of development is required. Results of gravity steam separation tests indicate that the combination gravity-mechanical dryer separation concept shown in the reference design for the 200-Mw(e) NuSu reactor is satisfactory. Tests to determine the performance characteristics of a modified Ge turbo-separator in a compact arrange-

ment were conducted at 1250 psi. Results indicate that less than 5% entrained moisture can be obtained with this unit operating at a steam-release rate of 35,000 lb/hr and a recirculation ratio of 17 to 20. (J.R.D.)

27211 (HW-61900 C) PLUTONIUM RECYCLE TEST REACTOR POWER TESTS. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 7, 1961. 88p.

The power tests performed prior to full scale operation of the Plutonium Recycle Test Reactor (PRTR) are described. These tests are classed as equipment checks, fuel loading and critical tests, shielding tests, approach-to-power tests, and full power tests. (T.F.H.)

27212 (JPL-TR-32-116) A TWO-FLUID MAGNETOHYDRODYNAMIC CYCLE FOR NUCLEAR-ELECTRIC POWER CONVERSION. David G. Elliott (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). June 30, 1961. Contract NASw-6. 14p.

One method for converting nuclear power to electric power without the use of moving mechanical parts consists of heating the working fluid to the plasma state and employing it as the moving conductor in a magnetohydrodynamic generator. For a light-weight system in the megawatt range, however, the plasma temperature required is beyond reactor technology. To circumvent this limitation it is proposed that the MHD generator employ a liquid metal as the conductor, the metal being accelerated by the vapor of a second fluid in a two-phase nozzle and extracted by a liquid-gas separator. From available data on such devices it is estimated that a cycle efficiency of 10% is attainable at a radiator-to-reactor temperature ratio of 0.7. For a reactor coolant temperature of 2000°F suitable working fluids are potassium vapor and liquid lithium. The estimated specific weight of the two-fluid MHD conversion system is comparable to that of turbine-driven systems. (auth)

27213 (NAA-SR-5608) FINAL SAFEGUARDS SUMMARY REPORT FOR THE PIQUA NUCLEAR POWER FACILITY. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1961. Contract AT(11-1)-Gen-8. 321p.

A description of the final design of the facility, and a summary of the analyses and conclusions pertaining to the safety of the final design are presented. An outline of operating procedures and organizations are also included. It is concluded that operation of the PNPF will not result in any significant hazard to the environment. (J.R.D.)

27214 (NDA-2159-1) INVESTIGATION OF GAS-COOLED REACTOR SAFETY PROBLEMS. Technical Progress Report for the Period September 21, 1960 through March 31, 1961. (Nuclear Development Corp. of America, White Plains, N. Y.). Apr. 30, 1961. Contract AT(30-1)-2303(XVII). 59p.

A review of the safety aspects of gas-cooled power reactors is presented. The survey indicated that the most severe accidents result from primary system component failures. Such accidents release fission products to the primary coolant and may cause damage to the reactor core. Transients caused by inadvertent reactivity additions are generally minor, since these are limited by strong negative fuel temperature coefficients, large core heat capacities, and the long neutron lifetimes characteristic of most gas-cooled reactors. (auth)

27215 (NP-9562) NUCLEAR ROCKETS FOR LIFTING MANNED STATIONS INTO SPACE. Holmes F. Crouch (Northrop Corp., Hawthorne, Calif.). [1960]. 14p.

For Presentation at the SAE National Aeronautic Meeting, New York, N. Y., April 5-8, 1960.

27216 (NP-10483) OEEC HIGH TEMPERATURE REACTOR PROJECT DRAGON. SECOND ANNUAL REPORT, APRIL 1, 1960–MARCH 31, 1961. (European Nuclear Energy Agency, Paris). 92p.

Dragon reactor experiments were conducted including fine structure flux measurements, control rod calibrations, flux and spectrum measurements, determination of conversion ratios and coefficients of reactivity. Reactor kinetics and safety studies were carried out on loading procedures, behavior at reduced coolant flow, approach to full power deposition of activity in the circuit, and evaluation of leakage of fission products from fuel boxes. Heat transfer studies were carried out on the prototypes at Winfrith. Work on impregnation to improve graphite was continued. Studies on the migration of fission products inside the fuel compacts and through the graphite walls of the fuel boxes were also continued. A design description of the helium processing plant is included. (J.R.D.)

27217 (TID-13305) SELECTED OPERATING EXPERIENCE OF COMMISSION POWER REACTORS. J. O. Roberts (Division of Reactor Development, AEC). [1961]. 43p.

For presentation at the American Inst. of Electrical Engineers, Summer General Meeting, June 18, 1961, Ithaca, N. Y.

The Shippingport station has demonstrated that the pressurized water reactor concept is capable of operating as a base or peak load plant. The EBWR has demonstrated that a direct cycle boiling water reactor can be operated without undue activity at the turbine. Availability factors greater than 90% were obtained for both concepts. The sodium and organic cooled concepts are in the reactor experiment stage; based on operating experience of reactor experiments, these concepts appear to have the characteristics necessary for central power station use. Maintenance experience was obtained on all types of reactors ranging from instrument calibration to major repairs and modification in areas of high radiation levels. Novel techniques and special tools were developed to perform many of the repairs. The manpower and time required for maintenance on the radioactive system is considerably higher than for similar type maintenance on conventional systems. Personnel radiation exposure levels have not exceeded AEC standards even though the level of activity in some areas requiring access were quite high. Radioactive waste, another problem area for nuclear plants, was successfully handled and disposed of without any major technical difficulty. (auth)

27218 (WCAP-1642) UPDATING OF THE 1959 STATUS REPORT ON PRESSURIZED WATER REACTORS. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Oct. 31, 1960. 99p.

Results are presented of a study to update the 1959 study of pressurized water reactors on a technical and economic basis. The study encompasses updating the design and estimating the total power cost of the 1959 281-Mwe plant, updating the 1959 100-Mwe plant, a review of the 1959 status report to incorporate subsequent changes, an outline of improvement areas for the two plants, an example of the 1970 potential design, and cost estimates of the potential plant examples. (J.R.D.)

27219 (WCAP-1643) 1960 STATUS REPORT ON SMALL PRESSURIZED WATER REACTORS. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Oct. 31, 1960. 104p.

Results of an investigation of present and future small pressurized water reactors are presented. The investigation encompasses the design of 12.65- and 44-Mwe plants. A review of the 1959 status report to incorporate subsequent changes in present technology, an outline of improve-

ment areas for the two reactor plants, examples of 1970 designs, and cost estimates for the potential plants are given. (J.R.D.)

27220 (AEC-tr-4508) THERMAL AND FAST BREEDER REACTOR POWER STATIONS PROGRAM. FUEL ECONOMICS—STORAGE PROBLEM—PLUTONIUM PRICE. J. Andriot and J. Gaussens. Translated from a paper presented at the Second International Conference on Operational Research, Aiz-en-Provence, Sept. 5-9, 1960. CEA report No. JaG/cm-SP/F/1 415. 48p.

The economic aspects of electric power produced by thermal and breeder (superregenerative) reactors are studied in order to optimize over-all costs of power programs using both reactor types. Two classes of programs are considered: those having zero Pu stock and those producing a fixed amount of electric power. Values are derived for the amount of Pu introduced into or extracted from the reactors which make up the programs. (D.L.C.)

27221 A CONCEPTUAL NUCLEAR PROPULSION SYSTEM FOR GROUND EFFECT MACHINES. J. C. Westmoreland (General Atomic Div., General Dynamics Corp., San Diego, Calif.), J. B. Dee, and J. E. Loos. Aero/Space Eng., 20: No. 7, 16-17, 59-64(July 1961).

The characteristics and performance of a ground effect machine which uses a nuclear propulsion system is described. From the results of an analysis, the smallest size vehicle, for which the installation of a nuclear power plant is feasible is described. A vehicle of approximately 306 tons gross weight is considered, and of this weight about 15 tons is useful load. A schematic layout is presented for the vehicle and the propulsion system. A closed-cycle helium-cooled system is also described as the nuclear power source. The characteristics of the helium-cooled reactor and the heat sink 75 Mw reactor are given for the system along with schematic diagrams of the system and the reactors. Also briefly described are the regenerators, power control system, auxiliary power, helium storage, auxiliary circulating system, and turbomachinery. A start-up method is presented for the power plant system. It is shown that hovering and forward flight performance determine power requirements of a vehicle capable of lifting its own structure, power plant, and 5% of the total weight as cargo and crew. Some applications of a ground effect machine are presented. (N.W.R.)

27222 STABILITY INVESTIGATION OF LOOSE COUPLED REACTOR SYSTEMS. G. Schweizer and R. Lauber (Technische Hochschule, Stuttgart). Atomkernenergie, 6: 242-50(June 1961). (In German)

It is well known that the dynamics of large power reactors can be approached mathematically as that of loose coupled systems. Not much work has been done in this field until now. The knowledge of the dynamics, however, is important for the design of automatic control-systems and for the stability analysis. A measurement of a loose coupled system with the two-slab-loading of the Argonaut Reactor was carried out. It was found, that the dynamics of the reactor can be described with a lumped transfer-function model. An automatic control system for this reactor loading was designed and built. It is possible to apply the linear stability analysis to the whole system in order to obtain the parameters of the controller. Further the stability analysis with the describing function method used to treat the nonlinearities of the kinetic equations is shown. The method has proved to be very reliable and useful in automatic control theory. (auth)

27223 THERMAL PROBLEMS OF GAS COOLED REACTORS. [PART] II. H. Benzler (Deutsche Babcock & Wilcox Dampfkesselwerke A. G., Oberhausen/Rheinland, Ger.). Atompraxis, 7: 264-8(July 1961). (In German)

Advantage of finned fuel surfaces, temperature distribution in fuel elements, relation between channel heat distribution and channel power, influence of control rod position, and cooling of channels in different radial positions are discussed. References are given. (auth)

27224 PRO REACTOR OPTIMIZATION CRITERIA. S. Baldetti (Montecatini, Milan), L. Bavestrelli, L. Biondi, and P. Fornaciari. Energia nucleare (Milan), 8: 413-21 (June 1961). (In Italian)

The principal optimization criteria are considered for the PRO organic cooled and moderated 30 Mw(t) experimental reactor. Within the contract specifications, the reactor can be designed for an optimum solution; this solution is the one that minimizes the cost of the experiment that takes place with the first reactor core. The cost of the experiment is determined by adding the construction cost to the experimentation cost and by substracting the residual worth of the plant at the end of the first core operation. This residual worth depends upon the capability the plant has of operating with succeeding cores. The items constituting the cost of the plant and of the fuel are examined. Also considered are the criteria by which it is possible, on the basis of the foreseeable characteristics of second cores, to increase the flexibility of the plant relative to the adoption of second cores. Calculation criteria are described by which the characteristics of many cores are examined; of these, two alternatives are shown as examples. (auth)

27225 THE FAST BREEDER REACTOR. R. V. Moore (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.) and R. Hurst. J. Brit. Nuclear Energy Conf., 6: 161-5(July 1961).

The basic concepts of fast breeder reactors are discussed. Included are the characteristics, advantages and disadvantages, and performance of the fuel elements, fuel cycles, heat removal systems, control and safety, and the place of fast reactors in the United Kingdom power program. (N.W.R.)

27226 DESIGN AND CONSTRUCTION OF THE DFR CORE, REACTOR VESSEL, FUEL HANDLING EQUIPMENT AND SHIELDING. J. Tatlock (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.), A. G. Frame, P. K. Richards, and R. Bellinger. J. Brit. Nuclear Energy Conf., 6: 166-88(July 1961).

The main problems encountered in the design, manufacture, and construction of the fuel element, core, reactor vessel, fuel element handling equipment, and shielding are described; and the solutions adopted are discussed in detail. The characteristics and choice of coolant are also discussed. (N.W.R.)

27227 DESIGN AND CONSTRUCTION OF THE DFR HEAT-TRANSFER CIRCUITS, STEAM-GENERATING PLANT AND REACTOR-CONTROL SYSTEM. R. R. Matthews (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.), W. G. Hutchinson, P. K. Richards, A. S. Fenemore, and M. H. Ewbank. J. Brit. Nuclear Energy Conf., 6: 189-210(July 1961).

The main problems encountered in the design, manufacture, and construction of the heat transfer circuits, steam generating plant, and control systems are described; and the solutions adopted are discussed in detail. An appendix is given containing data of the heat removal system for the 60 Mw(h) core output system. (N.W.R.)

27228 DFR METALLURGICAL PROBLEMS. C. R. Tottle (Univ. of Manchester, Eng.), D. S. Oliver, and K. Q.

Bagley. J. Brit. Nuclear Energy Conf., 6: 211-24(July 1961).

Metallurgical problems encountered in fuel element development and liquid-metal coolant technology are presented and analyzed. Methods and materials are discussed for eliminating swelling, irradiation growth, and thermal cycling effects. The physical, tensile, and creep properties of various canning materials are presented and discussed in terms of their compatibility with the sodium-potassium alloy coolants. The effect of impurities and oxide removal are discussed for the sodium–potassium alloy coolants. (N.W.R.)

27229 DOUNREAY FAST REACTOR PHYSICS. R. D. Smith (United Kingdom Atomic Energy Authority, Winfrith, Dorset, Eng.) and D. C. G. Smith. J. Brit. Nuclear Energy Conf., 6: 225-39(July 1961).

Calculations and measurements are discussed for some of the reactor physics parameters. The method generally used is to calculate the desired quantity in ZEUS and compare the calculated value with the ZEUS experimental result. The calculations are of two kinds: those which are needed early in the design of the reactor to predict certain characteristics (such as the critical size) which could be checked when the reactor is in operation, and more detailed calculations of the behavior of the reactor which are inconvenient or impossible to confirm by measurements in the reactor itself. The calculation of detailed reaction rates in most parts of the core and breeder and the kinetic behavior of the reactor under fault conditions are in the latter category. (N.W.R.)

27230 TESTING, COMMISSIONING AND INITIAL OPERATION OF THE DFR. J. L. Phillips (Dounreay Experimental Reactor Establishment, Caithness, Scotland), R. R. Matthews, and W. J. M. Davies. J. Brit. Nuclear Energy Conf., 6: 240-52(July 1961).

Testing, commissioning, and initial operation methods and procedures are described of some of the over 350 test schedules made. Major items are selected and described in fairly broad outline for a few of the test schedules. Some of the tests described are: sphere pressure test, primary liquid metal pipe weld tests, maintenance flask dry testing, and wet testing of the removal and replacement of equipment or charge and discharge operations. Other topics discussed are welding procedures, installation and calibration of outer and inner rotating shield and associated equipment including control rods, sodium–potassium filling, and critical assembly charging. A program involving operation of the reactor at low powers is also discussed. (N.W.R.)

27231 HPR–A 60 MW NATURAL URANIUM NUCLEAR POWER STATION. J. Brit. Nuclear Energy Conf., 6: 270-2(July 1961).

Construction and economics of a 60 Mw natural uranium, graphite moderated high performance reactor are discussed in terms of feasibility. The technical and economic issues raised on the comparative use of steel and concrete for the reactor vessel are debated. The size, output, and stresses are briefly discussed. (N.W.R.)

27232 IMPROVEMENTS RELATING TO THE GENERATION OF ELECTRICITY. Meredith Wooldridge Thring (to National Research Development Corp.). British Patent 870,446. June 14, 1961.

A method for generating electricity is described which converts the kinetic energy of a reactor coolant directly into electric current. In this method, the coolant, preferably an inert gas such as argon, is passed from a reactor through a magnetic field in a nozzle, and the resulting electric current is collected by spaced electrodes. The reactor is a latticed pile of unprotected uranium oxide and graphite moderators operated at 2000°C. The coolant is at atmospheric pressure and contains some gaseous fission products which ionize the coolant. This method offers the possibility of electricity generation at an efficiency of 50 to 60% as compared with 25 to 30% efficiency using steam as an intermediate stage. (D.L.C.)

27233 ARRANGEMENT WITH AN ATOMIC STATION. (to Aktiebolaget Atomenergi). British Patent 874,853. Aug. 10, 1961.

A scheme is proposed for constructing energy accumulators for use in the continuous operation of power reactors with varying loads. In this scheme, the accumulators are composed of one or more containers arranged in leaktight rock chambers in such a way that they are not in direct contact with the rock walls, the interspace being filled with a pressure-transmitting liquid, e.g., water. In use, the accumulators are shunted between the high-temperature and low-temperature sides of the pressurized water (secondary coolant) circuit. (D.L.C.)

27234 IMPROVEMENTS IN OR RELATING TO ATOMIC POWER PLANT. Friedrich August Henglein. British Patent 875,872. Aug. 23, 1961.

An atomic power plant is described in which a rotatable container has mounted therein a stationary reactor and a stationary heat exchanger. A granular coolant is provided in the container and, during rotation of the container, is urged around between the reactor and heat exchanger. The plant may be operated continuously in this manner, or, alternatively, the heated coolant may be delivered through a hole to a remote heat exchanger on a pulsed basis. The granular coolant may be graphite, a carbide, aluminum, zirconium, or some other metal. (D.L.C.)

27235 AUXILIARY COOLING SYSTEM FOR NUCLEAR POWER PLANT. (to Compagnie de Construction de Gros Matériel Eléctro-Mécanique). French Patent 1,202,843. Nov. 13, 1960.

To remove the heat produced in a nuclear reactor after a shut down consequent to a coolant failure, this heat is accumulated in a suitable mass by means of a heat transfer fluid, which may be the same as serves as reactor coolant. Preferably this mass is arranged inside a fluid tank in which the heat transfer fluid is held at a convenient temperature. This mass may consist of lead enclosed in steel tubes. (NPO)

27236 COMBINATION OF A NUCLEAR POWER PLANT WITH AN INDEPENDENT SUPERHEATER. Fritz Marguerre. French Patent 1,203,014. Jan. 14, 1960.

To adjust the energy output of a nuclear power plant running with constant power to the variable load requirement of an electric generating station, an auxiliary superheater is described which works only during the periods of peak load, in combination with thermal storage units, the steam of which may also be superheated by this superheater. (NPO)

27237 NUCLEAR REACTOR CONSTRUCTION. (to Sulzer Frères (S. A.)). French Patent 1,203,515. Jan. 19, 1960.

In a nuclear reactor the tubes wherein the coolant circulates, are surrounded by fissile material. The fissile material may be cast or sintered around the said cooling tubes, which may be made of steel or zirconium. Preferably the tube material is alloyed with a maximum of, for instance: (a) 1.5% Si and 5% Zr, (b) 1.5% Si and 1.5% Fe, or

(c) 7% Zr and 3% Nb. The cooling tubes may have external ribs for improving the heat transfer, and the mass of fissile material is preferably provided with grooves between adjacent cooling tubes. (NPO)

27238 METHOD AND INSTALLATION FOR THE PRODUCTION OF PRESSURIZED STEAM. (to Babcock and Wilcox Ltd.). French Patent 1,208,285. Feb. 23, 1960.

An installation for the production of pressurized steam comprises a gas cooled nuclear reactor and means to make the cooling gas circulate through the reactor and a heat exchanger in a closed circuit, so that the gas entering the compressor has an appreciably lower temperature than the gas entering the reactor. The gas that has been completely cooled in the heat exchanger enters the compressor at the lowest temperature of the circuit and is then reheated in a stage of the heat exchanger before entering the reactor, in order to avoid excessive Wigner growth as a consequence of too low a moderator temperature. This reheating is effected in a heat exchanger stage where the heating gas is already partially cooled. If the steam producing heat exchanger stages are completed by an economizer, the said reheating stage is situated between the economizer and the steam producing stages. (NPO)

27239 NUCLEAR REACTOR PRODUCING SUPERHEATED STEAM. (to Allis-Chalmers Mfg. Co.). French Patent 1,218,950. May 13, 1960.

A reactor core divided into two concentric sections is described. It has an outer boiling section and a central superheating section. Both sections contain fuel elements. The steam formed in the boiling section rises into the top of the reactor vessel and passes down through hollow fuel elements in the central section where it is superheated. The boiling liquid is water, which is in connection with the water constituting the moderator in the superheating section, and which circulates between this section through perforations in a cylinder separating the said two sections. (NPO)

27240 NUCLEAR REACTOR FOR THE PRODUCTION OF ENERGY WITH FISSILE ELEMENTS. (to Shell Internationale Research Maatschappij N. V.). French Patent 1,234,555. May 16, 1960.

A nuclear reactor is described which is cooled by a hydrogen refined furfural extract (b.p. 350-400°C) from recycle oils that are obtained in catalytic cracking processes. The refining is performed at 25 to 75 atm and 350 to 400°C, with utilization of a catalyst which consists of Co or Mo oxide on an alumina carrier. (NPO)

Production Reactors

27241 RADIOACTIVE ISOTOPES AND THEIR PRODUCTION UNDER NEUTRON IRRADIATION. "Review Series—Monograph Collection No. 15" of the International Atomic Energy Agency, Vienna. N. E. Brezhneva and S. N. Oziraner (Akademiya Nauk S.S.S.R.). 1961. 72p. STI/PUB/15/15. (In Russian and English). $1.00 (International Atomic Energy Agency).

An outline is presented of methods of producing radioisotopes in large quantities by neutron irradiation of various source materials in reactors. Progress in reactor construction has made it possible to produce powerful neutron fluxes with energies up to several tens of Mev. The production of radioisotopes by the (n,γ) reaction is easy, and the final nucleus is an isotope of the target nucleus. For significant radioisotope accumulation in this way, the irradiation time is of fundamental importance. Separation of the pure radioisotopes from the target material is complicated but may be simplified if the recoil energy of the atom is utilized as in the Szilard-Chalmers effect. Notable yields are obtained in the (n,α) and (n,p) reactions in most cases only when fast neutrons are used, but the radioisotopes can be separated by chemical means. For radioisotope production by neutron fission of heavy atoms, U^{235}, U^{233}, and Pu^{239} are the most promising. The yield of fission products varies widely from 1.6×10^{-5}% at mass number 72 to 6.45% at mass number 94. Some fission products are daughters and may be isolated in pure form, but most radioisotopes are contaminated by stable isotopes produced during fission. Methods have been developed for separating radioisotopic fission products from nuclear fuel. (D.L.C.)

Research Reactors

27242 (IEA-17) A NEW METHOD FOR THE INDIVIDUAL DETECTION OF FAILED FUEL ELEMENTS IN SWIMMING POOL REACTORS. P. S. de Toledo, M. D. S. Santos, R. Brenner, and A. C. Penteado (Brazil. Instituto de Energia Atômica, São Paulo). 1960. 8p.

Paper presented at the Third Inter-American Symposium on the Peaceful Application of Nuclear Energy, Petropolis, Brazil, July 16-23, 1960.

A method is described for identification of fuel element cladding failure in swimming pool reactors when one or more other fuel elements in the reactor core are releasing fission products. (J.R.D.)

27243 (NP-10486) SWEDISH REACTOR PHYSICS PROGRESS REPORT I. J. R. Fisher—R. A. Hoover, ed. (Nuclear Products-Erco Div., ACF Industries, Inc., Washington, D. C.). Apr. 1, 1957. 33p.

A series of criticality, flux, and reactivity analyses of the Swedish reactor completed during the period from November 1956 to April 1957 is described. Calculations were made for the required initial loading and maximum possible loading of U^{235} assuming a fuel enrichment of 20%, the critical mass, the total excess reactivity required, and the average temperature-density coefficient of reactivity. Values of the flux entering the 4 vertical test facilities in the corners of the core lattice are given. The methods, assumptions, imposed conditions, and definitions used to obtain the results are given. (M.C.G.)

27244 (NP-10487) SWEDISH REACTOR PHYSICS PROGRESS REPORT II. J. R. Fisher and W. M. Mallicoat (Nuclear Products-Erco Div., ACF Industries, Inc., Washington, D. C.). July 17, 1957. 7p.

The calculations of the critical mass and flux for the case of the center loop were completed. The methods used in the calculations and the final results are described. The compositions assumed for each region are listed. (M.C.G.)

27245 (NP-10488) SWEDISH REACTOR PHYSICS PROGRESS REPORT III. J. R. Fisher and William M. Malicoat (Nuclear Products-Erco Div., ACF Industries, Inc., Washington, D. C.). Oct. 4, 1957. 6p.

The results of calculations based on fully enriched fuel and a comparison of these results with the previous calculations which were based on 20% enrichments are presented. The configuration considered as the primary basis for comparison was that which contained the center loop. A decrease in loading of about 10% was indicated. The calculated values for the flux showed an increase in the enriched case. (M.C.G.)

27246 (NP-10489) SWEDISH REACTOR PHYSICS PROGRESS REPORT NO. 3A. John R. Fisher (Nuclear Products-Erco Div., ACF Industries, Inc., Washington, D. C.). Nov. 25, 1957. 5p.

The following possibilities were considered for raising the calculated values of the fluxes: a change in structural materials, redesign of the facility, and modifications of the designs. It was then decided that as a first approach, the physics calculation might be redone with the material volume percentages taken from the present design replacing the estimated values. It was found that the initial estimates of material percentages and the actual design percentages were not in very close agreement. These conditions indicated an increase in the thermal flux in the test facility over the previously reported results. (M.C.G.)

27247 (NP-10490) SWEDISH REACTOR PHYSICS REPORT, CONTROL RODS. J. R. Fisher and William M. Malicoat (Nuclear Products-Erco Div., ACF Industries, Inc., Washington, D. C.). Apr. 1958. 10p.

A summary is presented of studies that were made concerning the control of the Swedish reactor. The calculated worth of 6 control rods fully inserted in the reactor was 31% ΔK/K. A calculation was also carried out to estimate the worth of the rods when the center loop was in the core. The estimated value was 49.8% ΔK/K for 6 control rods fully inserted in the reactor. (M.C.G.)

27248 (JPRS-7043) ONE YEAR OF WWR-S REACTOR UTILIZATION IN POLAND. Ezhi (Yezhi) Aleksandrovich. Translated from Nukleonika, 5: 1-21(1960). 42p.

Information on experience of one year operation is presented. Modifications are described, and results of physics measurements are included. (J.R.D.)

27249 THE SAFETY OF RESEARCH REACTORS. J. F. Croft (Atomic Energy Establishment, Winfrith, Dorset, Eng.). Nuclear Power, 6: No. 64, 76-9(Aug. 1961).

The safety problems of research reactors are discussed. Safety of these reactors depends principally from the radioactivity of the fuel, the fission products generated within them, and the penetrating radiations emitted. The safety requirements for reactivity containments, control instruments and mechanisms, guaranteed supplies, and operations of the research reactors are described. The safety problems of high-flux reactors (10 to 20 Mwt) are discussed separately due to the complexity of the control systems. The problems involved in assessment of the safety document of new research reactors are also discussed. (N.W.R.)

WASTE DISPOSAL AND PROCESSING

27250 (HW-68116) RADIATION STABILITY OF SOME OF THE SOLIDS PROPOSED FOR STORAGE OF RADIOACTIVE WASTES. G. B. Barton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 2, 1961. Contract AT-(45-1)-1350. 13p.

To determine the radiation stability of some of the solids proposed for storage, samples of pure salts and simulated waste mixtures were irradiated in the beam of the Hanford Van de Graaff electron accelerator to doses of 5×10^7 to 6×10^9 rads (0.025 to 3.6% of the estimated infinite dose for solids produced from one year old waste). Collection of the gases liberated indicated that sodium nitrate would be an undesirable component but that sulfate, phosphate, phosphate-borate, or carbonate systems would liberate gases equal in volume to from only one half to ten times the volume of salt. These are probably in an acceptable range for a sealed system. (N.W.R.)

27251 (HW-70041) REMOVAL AND RECOVERY OF PLUTONIUM FROM 234-5 BUILDING SUMP WASTE WITH PHOSPHATE ROCK. A. E. Reisenauer and L. L. Ames, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 16, 1961. Contract AT(45-1)-1350. 14p.

The use of Florida pebble phosphate for removal and recovery of Pu from the acidic 234-5 building sump waste was investigated. Preliminary results indicated that selective adsorption of Pu on this material followed by elution with sodium carbonate is a feasible method for removal and recovery of Pu from dilute solutions. (J.R.D.)

27252 INVESTIGATIONS ON THE DEACTIVATION OF RADIOACTIVELY CONTAMINATED WASTE WATERS BY MEANS OF THE ELECTRODIALYSIS METHOD. S. Krawczynski (Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Ger.). Atomkernenergie, 6: 250-60 (June 1961). (In German)

The possibility for deactivating, by electrodialysis, waste waters which had been radioactively contaminated with nuclear products was examined. The desalting energy as a function of the number of the parallel cells and of the concentration difference between concentration and deconcentration cells was measured. When waste waters which had been radioactively contaminated with nuclear products were deactivated, the deactivation obtained proceeded approximately parallel to the deionisation for the ional radionuclides. The electrodialysis did not act on the colloids so that these must be removed from the water by other methods. The mechanical instability of the membranes is still an obstacle to a technical application of this method for deactivating large amounts of liquid; microscopically small hair cracks reduce the deionisation and therefore the deactivation efficiency. (auth)

27253 LOW ACTIVITY LIQUID WASTES. Nuclear Eng., 6: 329-32(Aug. 1961).

The treatment of low activity liquid wastes in the United Kingdom is described. Plant process layouts are shown for the Berkeley and Bradwell power station liquid effluent systems. The feasibility of three processes for use at various facilities is discussed. These processes include the phosphate process, ion exchange column methods, and the electro-deionization process. The material used in the construction of such processing plants is also discussed. (N.W.R.)